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THESIS

VIRTUAL MILITARY MARKETS

by

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VIRTUAL MILITARY MARKETS

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ABSTRACT

This thesis explores the utility of market mechanisms for Department of Defense (DOD) command, control, communication and collaboration (C4). Shortfalls in current C4 systems found by the Defense Science Board, Office of Force Transformation, and Command and Control Research Program are presented. Alternative C4 internal market structures that can help achieve the principles of Network-Centric Operations are illustrated. Then, using the principles of mathematical model development, the thesis builds a testable "E-Bay" type model for applying markets in the DOD. The model is not validated or tested in the space of this thesis and should undergo experimentation. Next, this thesis walks through an intelligence use case and presents a number of testable hypotheses for model validation. Two Appendices are included, the first discusses decision making in markets by taking existing decision making tools to show how the cycle of information can be improved for the decision making commander in market transaction space. The second appendix is a briefing that highlights the key points of the Virtual Military Market (VMM) and the intelligence use case. The thesis concludes that "practiced adhocracy" and improved decision making can be achieved by the VMM and that DOD should explore this concept further.

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ACKNOWLEDGMENTS

Thoughts about this thesis started in my fall 2004 *Warfare in the Information Age* class with Professor John Arquilla. In a lecture Professor Arquilla presented the idea of posting tasks on an E-Bay type website to be grabbed by operational troops. That nugget sparked a thought in my mind of not just posting operations but actually "marketizing" the choice of force solutions by costs and performance factors. I thought about this a bit, and encouraged by Professor Arquilla to "hold on to that thought", I decided to explore markets in my thesis. I had a brief discussion with Professor Dorothy Denning, about the topic at the start of winter classes in January '05. I can attest that the Denning family is communicating! The next day I met Professor Peter Denning and Professor Sue Higgins for the first time; Dr. Denning wanted me to work a deal with E-Bay to get a copy of their market software and start to develop the market. My response was… develop what? Thanks for the inspiration and guidance from Professor Arquilla and the energy and belief from the Denning family that encouraged the pursuit. Thesis advisors Professors Sue Higgins and Frank Giordano each added their own contacts and research perspectives to make this a complete effort. Special thanks to my cast of mentors and supporters for their reads, inputs, perspectives, and comments. I really appreciate all of the help.

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I. INTRODUCTION

This chapter lays out the purpose behind this thesis as well as the scope of the effort. Essential terminology and the methodology used during this research are presented.

A. VIRTUAL MILITARY MARKETS?

This Virtual Military Market (VMM) thesis starts to paint the picture of how E-Bay like markets can be utilized by DOD for command, control, communications, and collaboration (C4). Capital markets with profit incentives are not the focus of this study; the organizational principals of markets that produce effective distributed operations capabilities--especially for decision making and information sharing-- are central to this study. "*Self-synchronizing*" and "*demand driven*" are force transformation buzz words; they are also terms that have been associated with markets throughout history. Consumers drive markets and create opportunities for solution providers to meet their demands—in other words markets synchronize supply and demand. These principles are time tested; market mechanics and their decentralized principles are ways of thinking about coordination that have existed since the Byzantine Empire.

A new breed of market, called a virtual market, has emerged at the intersection of markets and information technology. These markets provide extensive reach to the most distant of consumers. Today the web offers virtual markets such as E-Bay and Amazon (E-Bay, 2005). Something closer to what is being illustrated here is called Elance. Elance is a professional services market that allows accountants, web designers, translators and others to bid on buyer requirements (Elance, 2005). This type of market is often referred to as a reverse or buyer's market. E-Bay, Amazon, and Elance are good examples of global markets, enabled by information technology. These information age markets are available to anyone with internet access, and enable the realization of another transformation phrase, "Power to the Edge" (Albert & Hayes, 2003).

Virtual markets are not technically difficult; they have just extended the reach of the consumer and supplier. This fact is the key to market utility-- no matter the complexity of virtual markets use-- what is important about them is their ability to link

the demand of consumers with the innovation of suppliers. Translating that into the military environment, this thesis illustrates how virtual military markets are able to respond to the needs of the Joint Forces Commander's demands for: information and intelligence, the development of new solution sets for effects-based operations, and reach to remote & specialized skills of all types.

How the C4 demands of routine operations, crises and planning can be met by the VMM, as well as how a repository of unprecedented knowledge is created are explored throughout this thesis. Imagine a crises event that has just happened; you now turn to an E-Bay like market for your decision making needs. In short order, the accumulated knowledge and experience of your forces start presenting available solutions. They collaborate to develop new solutions; you are now able to distinguish between your choices by mission essential and other relevant factors. The crisis certainly wasn't planned, but the routine use of the VMM has refined this method of C4 and you have great confidence in the solutions presented by your forces. This strategy takes advantage of the knowledge and power of the many and represents a vision of the knowledge age.

B. SCOPE

This section lays out the research questions that are answered in this thesis, states some of the assumptions used during the research as well and the limitations and delimitations of this study.

1. Research Questions

- Why a market model? What are the conditions that prescribe this type of alternative C4 mechanisms? Why change?
- What are internal markets and how can they contribute to DOD C4?
- What variables are needed for a DOD internal market model? What are the essential "macro" variables required for market existence, and what are the some of the "micro" transaction variables to facilitate market effectiveness?
- How would this model be used to improve the Intelligence process? What are the testable hypotheses for market validation?
- What are the market model's counter arguments, and can they be overcome?

2. Assumptions

This thesis assumes that available networks and communications mechanisms are in place to provide market access down to the unit level. Virtual markets are based upon web enabled open standards technology.

3. Limitations/Delimitations

This thesis develops the virtual market based model through the third step of model development; it does not test or validate the model beyond logical conclusions. This study is focused on building the transaction level of markets (individual exchanges) versus analysis capabilities for those transactions.

C. DEFINITION OF TERMS

Adhocracy: this thesis uses the word in an aggregate form from a combined definitional basis to mean-- without bureaucracy, focused to a purpose with available resources, and an organizational form.

Internal markets: markets that are used as C4 mechanisms within an organization or other defined community.

Market mechanisms: those processes needed to facilitate market exchanges from requirement presentation, solution presentation to post transaction analysis.

Transaction space: the virtual network location where exchanges are made.

Value basis: a mechanism to show resource use. This thesis doesn't attempt to provide a representation of the "true value" of information, resources, human time or life. Instead value is an expression of the quantity of those resources used in solutions and record of quality historical performance metrics. This value basis may be used by other analysis methods to consider true value but are beyond the scope of this thesis.

D. METHODOLOGY

Three primary research methods are used in this thesis; a heuristic review, model development, and use case presentation.

1. Heuristic Communication Structures Review

The first part of this thesis reviews the need for alternative C4 structures as well as information sharing strategies. A review of related literature on communications enabled organizational structures is presented, specifically highlighting the internal

markets solutions made possible by the presence of today's advanced communications architectures. Organizations that have used internal market are explored along with the basics of virtual exchanges and communications in commercial markets.

2. Develop a Military Market Model

This portion of the thesis builds a market model designed for military planning and operations. A military business process is presented that uses the characteristics and mechanics of a virtual market previously reviewed. Some portions of this market require experimentation for validation of the concept developed here. The market model construction begins with the methodology found in the text *A First Course in Mathematical Modeling* as a framework to help determine steps required to bring virtual markets into the DOD (Giordano & Weir, 2003). The following steps are used to develop this market model:

Identify the Problem: The first step to create a market model, or develop a specific market, is to identify and make a clear statement of the problem that is answerable with the virtual market model. The problem must be translated from a verbal description to market model variables. This is accomplished by the development (and then application) of macro market model variables that are presented in the first part of the model development chapter. This first step helps market creators identify what circumstance markets can be used by the DOD. These macro variables are the prerequisites necessary for virtual market existence.

Once the need for a virtual market is determined, the next step is to develop the micro variables and transaction space that create the improved decision making, problem solving, or information demands presented in the problem statement. Some of these variables are products of the circumstances or they are derived from other processes or submodels and serve as prerequisites for model employment, it is very important to understand these dependencies in market development.

Make Assumptions: Simplify the task by reducing the number of factors under consideration. Determine what behaviors influence the problem. Analyze these variables to establish the relationship between them and then classify dependent and independent variables and identify submodel interrelationships. In this case, one market at a time

should be considered using a constant set of macro market components, then developed taking into account the micro market aspects of the transaction space.

Solve or Interpret the Model: Use an iterative process to determine if a market model can be built by either simplification or refinement to produce a working model that can undergo testing and experimentation. Simplification may involve reducing variables, setting constants, adding more assumptions. Refinement may expand variables under consideration, allow variations, or reduce assumptions. The scale of a market can range from one specific course of action to an entire market facilitating the exchange of all of an organization's business process information. The ultimate refinement of virtual markets could consider the analysis and relationships of all markets together in the virtual space. This thesis discusses an intelligence market, which is just one type of operational military market.

Verify the Model: Test or experiment with the market model. First, does the model answer the problem stated in step one, and does it make common sense? This logic check will be accomplished within this thesis by developing and discussing the intelligence use case. Measurable results will be proposed for validation. Validation is an essential next step, and is accomplished with experimentation, simulation, or in Joint Force exercises. This second step is not accomplished in the term of this thesis; however suggestions for experimentation are given.

Implement the Model: Establish a joint forces market for improved command, control, and collaboration of decision making and/or facilitate intelligence sharing needs. This step is beyond the scope of this thesis; however a way ahead to achieve this is suggested in the conclusion.

Maintain the Model: This step moves the development of markets into the maintenance of markets. Steps one and two are reevaluated to consider if the market still solves the problem presented in step one with the assumptions of step two. This step checks the continued validity of any submodels that facilitate the market model (Giordano & Weir, 2003).

3. Present a Use Case

This portion of the thesis walks through a military use case. The intelligence use case presents the adaptation of the military market model with the intelligence process. In this way it illustrates the market elements and transactions necessary to develop this collaboration and control environment. Testable hypotheses are presented for the case

E. CONCLUSION

This thesis explores the utility of market mechanisms for DOD C4. A heuristic review of shortfalls in current C4 systems found by the Defense Science Board, Office of Force Transformation, and Command and Control Research Program are presented. Alternative C4 methods are explored and internal market structures that can better help achieve the principles of Network-Centric Operations are illustrated.

Using the principles of mathematical model development, the thesis builds a testable virtual military market model. This model is not validated or tested in the space of this thesis and should undergo experimentation. Next, this thesis walks through an intelligence use case and presents a number of testable hypotheses for model validation.

Two appendices are included, the first discusses decision making in markets by taking existing decision making tools to show how the cycle of information can be improved for the decision making commander within market transaction space. The second appendix is a briefing that highlights the key points of the VMM and the intelligence use case.

II. COMMUNICATIONS ENABLED STRUCTURES

This chapter reviews the need for alternative command, control, communications, and collaboration (C4) to better achieve the tenants of Network Centric Warfare/Operations (NCW or NCO). The advancement of communication enabled networks and the alternative organizational structures, such as internal markets that can establish C4 relationships, that emerge are important concepts behind this model and are also explored. This chapter then looks at lessons learned from commercial use of internal markets and examines commercial market practices. The chapter finishes with an introduction to the principles of social network analysis and how these principles can indicate market locations.

A. NETWORK-CENTRIC WARFARE

NCW is the Department of Defense's cornerstone transformation concept to address new strategic and operational challenges. The lead office for these efforts is the Office of Force Transformation (OFT) in the Office of the Secretary of Defense (OSD). OFT offers the following tenets of NCW:

- A robustly networked force improves information sharing.
- Information sharing enhances the quality of information and shared situational awareness.
- Shared situational awareness enables collaboration and self-synchronization, and enhances sustainability and speed of command.
- These, in turn, dramatically increase mission effectiveness (OFT, 2005A).

The purpose of this market model is to help achieve these tenants. Mission effectiveness is the ultimate goal of any military effort; therefore these tenants will never be far from the thinking through of this thesis development.

1. Network-Centric Warfare

OFT presents a number of ongoing projects/experiments and provided their status in an August 2004 Progress Report and its January 2005 publication-- *The Implementation of Network-centric Warfare*. Ongoing efforts include: Blue Force Tracking, Horizontal Fusion, Sense and Respond Logistics, Common Relevant Operational Picture for Joint Forces, The Standing Joint Force Headquarters,

Collaborative Information Environment, Distributed Common Ground/Surface System, Dynamic Joint ISR Concept, and the Joint Interagency Coordination Group. The services have their own NCW efforts: the Air Force's Constellation Net, the Navy's ForceNet, and Army's Objective Force. All of these initiatives are using some of the following OFT principles for implementing NCW: Information superiority, shared awareness, speed of command and decision making, self-synchronization, dispersed forces, demassification, deep sensor reach, and combine these principles to alter initial conditions at higher rates of change and reduce compartmentalization of process and functions between services. (OFT, 2005A).

Of these principles, those that can be achieved technically are present in ongoing OFT projects (OFT, 2004A). However, those that involve structural changes or changed operating concepts are not as evident. Mr. John Luddy from the Lexington Institute provides a separate analysis of NCW efforts by examining operations in Afghanistan and Iraq. He looked at close air support, long range control of Intelligence Surveillance and Reconnaissance Unmanned Aerial Vehicles (UAV) as well as ground force supporting UAVs. Communications initiatives like the Global Information Grid were identified as enablers of NCW. He found both successes and failures in NCW efforts as well as room for growth. Increased speed of targeting was a NCW positive; however fratricide and civilian collateral damage represented the other side of the coin. He also found that information didn't flow to the field as well it did coming back from the field (Luddy, 2005).

NCW doesn't replace the leadership, training, and experience of the warfighter; the less tangible human aspects of warfighting are still critical. In short, technology can only do so much. NCW was demonstrated in Operation IRAQI FREEDOM and Operation ENDURING FREEDOM, however it wasn't entirely validated. Many of the transformation efforts mentioned so far are technology based, they haven't yet changed strategies or planning tactics, and they haven't taken advantage of decentralized C2 (Luddy, 2005).

New practices in knowledge and information management are critical for effective NCW. Getting the right information, with the correct level of granularity, to the

tactical level and combatant commander is very important. Providing vast quantities of data not tailored to the situation risks information overload for the operational commander, especially at the tactical level. It's a fine line between understanding a common operational picture and having too much data to sort and act upon, thus the development of common plans, operational concepts, and processes are just as important as the technology that makes them happen. OFT recognizes this and tracks NCW changes in doctrine, organization, training, technology, leadership and education, personnel, and facilities at the same time. However, not many ongoing initiatives focus on these human aspects of NCW.

Luddy commented on this relationship between technology and culture and presented some shortages in NCW:

> Network-centric operations require technology, but they ultimately rely on people and organizations. As technology improves, the military must make similar advances in its institutions, processes, and culture. Analysts and practitioners alike agree that the human aspects of military operations--training, doctrine, and leadership development--still need to change (Luddy, 2005, p.12).

In other words, as NCW progresses, new concepts that utilize the full range of NCW strengths must be established. Direct connections to these principles will be shown for this market force model by the end of this thesis.

In their 2004 summer study *On the* T*ransition To and From Hostilities*, the Defense Science Board (DSB) recognized a number of DOD capability shortfalls including: stabilization and reconstitution capabilities; strategic communications; knowledge, understanding, and intelligence for the 21st century; identification, location, and tracking for asymmetric warfare. The DSB report memorandum advocates for "a new approach that will establish systematic ways to access and coordinate the vast amount of knowledge both within and outside DOD." One critical element is "intelligence reform that allows analysis to drive collection and fosters a more integrated community." Many of these "capability" shortfalls may actually be "process shortfalls", and if looked at differently, some of our current force capabilities may be able to step up to meet some of these needs. A new process approach to make this possible is central to this thesis and may help achieve the DSB's recommendation for the intelligence

community to organize and integrate resources around problems, as well as other recommendations.

2. From Collaboration to Self Synchronization

Today's DoD network collaboration is epitomized by the Common Operational Picture (COP), a digital picture that identifies friendly and adversary forces usually seen at the Joint Forces Command level. The COP greatly enhances shared situational awareness for battlefield coordination. It is also an example of how information is centralized and controlled at higher levels of command, enabled by NCW communications capabilities. One unfortunate side effect of these capabilities has resulted in senior leadership micromanagement instead of properly placed information and resultant decentralized decision making.

> Networks allow for collaborative planning throughout the chain of command, which can develop more effective plans faster. But the same collaboration allows senior level commanders to micromanage. Military operations rely on a properly functioning chain of command, where commanders at each level have a manageable span of control and can focus on operations at their appropriate level. As real-time battlefield information passes before senior commanders, there will be a temptation to over-direct small units and lose focus on broader objectives. One of the U.S. military's greatest strengths is the initiative of small-unit commanders; if these commanders grow accustomed to centralized control from above, they may grow hesitant and indecisive (Luddy, 2005, p. 11).

The DOD needs to take full advantage of networked communications capabilities including the benefit of decentralized capacity and the full power of the network. Network theory offers at least two measurements of communications capability: Moore's Law about information storage and processing capacity doubling every 18 months and Metcalfe's Law about the value of the network as the square of the number of nodes present. Could the power of NCW ever be determined so simply? Probably not, however a simple correlation would show that the capabilities enabled by NCW are not being fully achieved. This criticism is being realized and is the subject of a recent Information Age Transformation Series Book entitled *Power to the Edge: Command and Control in the Information Age.*

> Power to the edge is about changing the way individuals, organizations, and systems relate to one another and work. Power to the edge involves the empowerment of individuals at the edge of an organization or, in the case of systems, edge devices…Moving power to the edge implies adoption of an edge organization, with greatly enhanced peer-to-peer interactions. Edge organizations also move senior personnel into roles that place them at the edge…Command and control become unbundled (Albert & Hayes, 2003, p.5).

This book, a Command and Control Research Program (CCRP) publication, was written to explain why current C4 concepts, organizations, and systems fail to meet today's needs. The power to the edge concept calls for commanders to establish the prerequisite initial conditions that enable decentralization including enterprise wide understanding of commander's intent, dynamic resource allocation, and rules of engagement. Along with quality information, shared situational awareness, and competence these initial conditions are really the basic elements of trust (in information, personnel and equipment) that are required to successfully implement new C4 methods. C4 are critical to all forms of warfare and are not treated lightly because they span all four domains of warfare (physical, information, cognitive, and social). Historically, the least centralized approaches to C4 have used mission specific directives, where decisions were left to subordinates on how to achieve them. However, control-free C4 has been rarely used in military warfare since communications capabilities have been available. The goal of the power to the edge concept is to re-enable the NCW tenant of self synchronization. This will be possible where circumstances allow its realization; on the other hand, central decision making will continue to be merited for situations where the prerequisite conditions have not been established (Albert & Hayes, 2003).

One specific communications capability, the internet protocol allows changes in knowledge management from a push to a "post and smart pull approach." Alberts and Hayes show how this changes the burden of determining information relevance/utility from the information owner/producer to the information user and make both suppliers and consumers smarter (2003). Information age processes tap collective knowledge and collaboration, rather than relying on single decision makers. These collaborative processes have been shown to be efficient and more likely to produce better solutions and

decisions. The following minimum organizational characteristics and capabilities are required to complete military operations effectively:

- The ability to make sense of the situation
- The ability to work in a coalition environment including nonmilitary partners
- Possession of the appropriate means to respond
- The ability to orchestrate the means to respond in a timely manner (Alberts & Hayes, 2003, p. 98).

These capabilities will be the determinants of successful strategies that utilize the full power of the network for both the system and human side of the equation and measures of the organizations power. These are the types of capabilities needed to achieve the deficiencies described in chapter 1 of this thesis. Alberts and Hayes summarize that the reason for moving power to the edge is to increase organizational power:

> This additional power is related to a corresponding increase in organizational agility. The source of the increased power comes from (1) an improvement in an organization's ability to bring all of its information and all of its assets to bear, instead of only a fraction of its information and assets, and (2) the ability to recognize and take advantage of fleeting opportunities (Alberts & Hayes, 2003, p.213).

Decentralized or de-coupled C2 is both possible and desirable with our communications enabled networks. What is left to determine is what form of decentralized organization can be used and when and where is it appropriate vice traditional C2 hierarchies, or some mix of the two? This subject is examined in the next section.

B. DECENTRALIZED ORGANIZATION THEORY

New organization forms are needed to take advantage of that the advances in communications allow and achieve the tenants of NCW. John Arquilla and David Ronfeldt recommend coupling both organizational forms with available technology in their *Swarming & the Future of Conflict* book (2000). New roles for middle management and organizational flattening have proven successful in commercial business processes and may help the military attain effectiveness in planning and operations not present today. This section covers basics organizational forms and then demonstrates new

hybrid structures enabled by advanced communications. The chapter finishes with a discussion of the Sense and Respond Logistics (S&RL) project which takes advantage of existing business processes and market principles.

1. Mintzberg's Organizational Forms

Henry Mintzberg defines organizational forms based on the environmental complexities and pace of change (uncertainty) that an organization is part of:

- Machine Bureaucracy: complexity is simple, stable environment. Uses the coordination mechanisms of standardization of work processes and/or outputs.
- Entrepreneurial Startup: complexity is simple, dynamic/changing environment. Uses the coordination mechanism of direct supervision.
- Professional Organization: complex, stable environment. Uses the coordination mechanisms of standardized skills and/or norms.
- Adhocracy: Complex, dynamic environment. Uses the coordination mechanism of mutual adjustment (Beshears, 2005).

The Apollo 13 response team is a classic illustration of an adhoc teams formed to meet a purpose. DOD Joint Task Forces, at least initially, are adhocracies of various personnel and assets gathered to focus their efforts on a particular operation. Within this taxonomy, markets are in the quadrant of adhocracy in highly complex environments that are constantly changing. Markets offer a decentralized structure; they are not really organizational forms at all, but transaction spaces between individuals and organizations that focus relationship and exchanges to meet requirements.

Because of their decentralized control and use of mutual adjustment, both adhocracy and markets might as well be evil terms when used in the military context. Mutual adjustment is achieved between solution provider and requirement demand. It is important to understand that in many cases adhocracy works only in the company of other organizational forms, this is true in the case of market mechanisms. Markets exist between existing organizational entities. Markets do not replace participating organizations and they may not change the internal structures/processes of participating organizations at all. Their use as alternatives for C4 is discussed next.

2. Communications Enabled Structures

To keep up with the challenges of the information age, new strategies for organization and command and control are needed. Actual strategies to accomplish this

transition are yet to be presented. This thesis looks outside of DoD literature for examples and ideas of how to bring decentralization to the military forces.

In his book, *The Future of Work,* Thomas W. Malone discusses alternative organizational types. He illustrates a paradox in communications capabilities that both drove centralization of societies, from bands to monarchies; and today allows for decentralized democracies. He argues that this model for social structure change can be applied to businesses. Decisions to decentralize are made when the benefits of increased freedom, motivation and flexibility are greater and more advantageous than the increased communications infrastructure costs to do so. Malone outlines four types of organizational structures that take advantage of decentralization: loose hierarchies, democracies, external markets, and internal markets (2004). This thesis develops the idea of internal DOD markets for efficient and effective decision making.

How do internal markets work? Markets have been around since early history. The concept of a market is that buyers and sellers meet to exchange goods or services. Prices in markets are most often determined by supply and demand. The concept of internal markets involves getting solutions from existing organizational resources and personnel using a buyer's market approach . The communications structure of markets is an "all channel network" where both existing relationships and new relationships can be formed. Competitive decisions are reached by mutual agreement and incentives to participate are usually to maximize your profits (more income than expenses).

Some companies are now establishing more formal internal markets. For example, Hewlett-Packard has developed a market for new ideas from its employees. Any employee can submit a new idea to a senior management board. The board determines funding for the most promising ideas. The idea becomes a project and is posted for employees to volunteer to work on; the project leader determines who works on the project. This internal market facilitates innovation and aligns skill by the project and makes formal reorganization unnecessary. A more explicit market would be present if the board allocated operating funds based on the projects, and employees receive their income and/or bonuses with this method (Malone, 2004).

Exchanging information is another example of an internal market. One example of an information market uses knowledge of the participants to make future predictions, this market doesn't involve buying or selling products or services-- its more like taking bets about the future. The idea is about the "wisdom of crowds" or as this thesis suggests the knowledge and power of the many. The DOD tried out an "idea futures market" in 2003, but that was a public relations disaster (Malone, 2004). However, demand based knowledge sharing with proper incentives can be very effective to capture organizational wisdom, and are untried.

Malone and other MIT colleagues have simulated internal market models for manufacturing firm capacity. They were trying to explore the possibility that capacity could be allocated more effectively with a decentralized market process. In the simulation, Malone's team reached nearly perfect efficiency.

There are several advantages of internal markets. First, everyone can see the whole picture, not just the planners. In the manufacturing example, if a factory goes down unexpectedly, the value of factory capacity elsewhere goes up. The other facilities find it in their interest to take some of the failed factory's work. Next, the ability to adapt to changes, flexibility, and speed of decisionmaking are all increased. When new situations or requirements are presented, more minds can work the problem and options can be explored simultaneously. Market forces make resource allocation very efficient by meeting the needs of as many as possible.

Motivation to participate in the market can be achieved with proper incentives—example incentives include compensation, bonuses, or promotion material. Increased autonomy and creativity can often be incentive enough for many cases. Internal markets for organizations can be for products, services, or information. Historically, markets are established for different reasons. Here is a summary of market functions:

> **A forum for exchange**: This is perhaps the most classical definition of a market: It is to enable buyers and sellers to find each other. Town bazaars and stock markets would fall under this label.
>
> **An arena for competition**: The structure of competition may of course vary depending on the number of buyers and sellers but the primary function of a market appears to be the cultivation of sufficient amount of competition to ensure economic efficiency.

An avenue for choice: Economic efficiency is only meaningful to the extent people can exercise choice – markets allow individuals, at least in theory, to make the kind of consumption choices they prefer. Prices capture this information and direct the production of goods and services.

A process for endorsement/external validation: Markets are powerful mechanisms for endorsing and validating (or rejecting) product and service offerings. Markets gather information from a number of individuals and aggregate this information.

A mechanism for resource allocation: Due to the signaling effects of markets, resources become allocated toward their most efficient use. Although in theory the allocation processes are continuous, in practice corporate strategic planning and capital budgeting cycles render such decision making an annual event hence slowing down resource allocation adjustments in the market place.

A kind of social network: Markets exist within the social context of a particular culture, defined by a set of institutions, and historical evolutions. To function, markets are supported by social networks of brokers, financial and other intermediaries, buyers, and sellers (Välikangas & Hamel, 2001, p.5-6).

Each of these functions provides different reasons to establish internal markets. Combining Malone's internal markets with the ideas of Mintzberg's organizational forms, virtual markets are transaction spaces that facilitate "practiced adhocracy". In other words, they routinize the process of presenting problems to markets and solving them with market provided solutions. The Sense and Respond Logistics model presented next illustrates market principles being utilized for resource allocations. This thesis builds a military model to use internal markets for C4.

3. Sense and Respond Logistics

One project being pursued by the OFT is the S&RL project. Intended to close the growing gap between the logistics community and NCW combat systems. Without being named a market the S&RL project utilizes many "market like" mechanisms. The S&RL project is described as: "knowledge-enabled, demand driven" where:

- Support networks are dynamic
- Negotiations-based relationships are the basis for changing rule sets
- Networks are robust and difficult to analyze or attack
- Distributed, adaptive operations are supported (OFT, 2004B, p.16).

The goals of S&RL are to increase logistic robustness, commander's flexibility on dynamic battlefields, and logistics agility to react quickly to environmental and new mission changes. S&RL borrows the sense and response adaptive managerial framework originally developed by IBM. The S&RL idea takes advantage of networked infrastructures, but also goes to the next level of operations support based on knowledge based demand networks. The prime metric for S&RL is speed/quality of effects. S&RL combines NCW theory and Joint Adaptive Expeditionary Warfare practices by taking advantage of network theory, complex adaptive systems, and chaos theory (OFT, 2004B).

This project has another noteworthy corollary to this research. S&RL has taken a business practice, related it to the military environment, and developed relative concepts to be used by the military. OFT's summary of S&RL's commercial ideas supporting NCW, the adaptation needed for the military operations, and finally its operational concepts are presented in a May 2004 concept paper.

A couple of observations are interesting about the S&RL concept. First, when taking commercial principles and applying them to the military context, careful consideration should be taken when making the concept fit the military environment. Second, while S&RL has not been called a market enabled program, it certainly fills many of the market roles described earlier by Välikangas & Hamel. Take for example this one resultant concept from the military application of this business process:

> Networked adaptive logistics supported by a community of software agents that represent logistics suppliers, consumers, and resources
>
> - Sense and respond mechanisms identify (sense), request (demand), and support (supply) logistics needs
> - Full battlespace perspective of potential and opportunistic consumers, suppliers, and logistics transportation and distribution (including logistics resources outside the supply chain)
> - Using situational awareness and commander's intent (plans, orders, tasks, effects, targets) to assess, prioritize, and reduce risk in S&RL
> - Using feedback, lessons learned, and experience from the agents to adapt the logistics effort, primarily through continuous planning, short-term supply chain optimization, and supply chain event management (OFT, 2004B).

Demand driven consumers, supplier provided resources, information exchange, avenues for choice, resource allocation, and the presence of technical and human network are all present in S&RL. S&RL utilizes "agents" that are acting in a virtual transaction space. Additionally, S&RL C2 relies on distributed decision making, local self synchronization, shared situational awareness, and speed of command. Perhaps the principle of using virtual markets is not so inconceivable for military forces; it may already be in development in the logistics community.

C. LESSONS FROM INDUSTRY

This section illustrates the use of internal market systems by commercial and non-governmental organizations. It also presents the functional aspects of commercial virtual markets.

1. Internal Markets in Industry

IBM poses the following question about the internal markets: "If free markets allocate resources and set prices so efficiently, why not build market mechanisms inside corporations—to make them work better from the inside out?" (IBM, 2004) Actually some corporations have been very successful with internal markets. British Petroleum, Intel, and Ford Motor Company have successfully used the concepts of internal markets to enhance operations. Certainly introducing markets into existing hierarchies can be difficult. However, a 2001 paper by Välikangas and Hamel present some case studies of traditional hierarchies that have developed internal markets successfully.

The World Bank Development Market Place was a market set up in 2000; the market was a two day event that generated ideas about grassroots development options. The World Bank's traditional bureaucratic thinking was successfully overcome by making $300 million available to about 300 projects presented in this marketplace. The marketplace received ideas from all over the world and had good results. In 2001, four projects of the nine strategic initiatives ongoing at the World Bank were introduced in this market (Välikangas & Hamel, 2001).

Royal Dutch/Shell's Exploration and Production division has an innovation process called GameChanger. GameChanger solicits ideas from Shell employees, selected universities, and partners; and uses and operational budget of .1% of the division's earnings in 2000. GameChanger successfully produced four of the five largest

growth opportunities for the company. Key to the success of GameChanger was both its connections to, and independence from, the rest of the organization. IBM's alphaWorks is unique because it reaches out to software developers outside the organization, allows them to download new code and expand it into technology for a free evaluation period, and offer feedback on the code. Developers are motivated to work with the code to possibly get a head start on developing new technology, while IBM gets important developer feedback and secure loyalty among developers. This market pull has increased the software deployment process from two/three years to six months. The authors summarize that the hierarchies of the industrial age will be replaced with structures like markets that facilitate innovation (Välikangas & Hamel, 2001).

How difficult is it to set up internal markets? Charles Plott, a California Institute of Technology economist, presents four difficulties presented by markets:

- **Speed.** A market can react too slowly. People must have incentives to post information early and not wait until the last minute to bet on the winner.
- **Visibility.** How much visibility should participants have into the bidding process? The ability of bidders to see what others are willing to pay will affect bidding behavior.
- **Timing.** Should bidders be allowed to change prices after their initial posting? When will the market be open?
- **Participants.** Should non-experts be allowed to participate? Plott's research shows that speculators can improve the performance of markets that predict future results. 'It makes the market deeper and reduces variation,' he says. 'When speculators read how other people bid, they act like grease to make the system work more smoothly' (IBM, 2004).

These successful implementations of markets in traditional hierarchies are a good sign that markets can find a home in hierarchies, even one as rigid as the military. However, these difficulties along with military specific constraints & restraints need to be considered and either mitigated or overcome during market development.

2. E-Bay and Elance

This section describes how commercial virtual markets function. A very well know virtual market is E-Bay: It is basically a sellers market, self depicted as "the world's online marketplace." Now look at E-Bay a little more analytically--what makes

it work? How is trust established to assure transactions? The 17 page user agreement provides clauses applicable to both buyers and sellers. Trust is partially established and provisioned for by the site. The buyer and seller have a "performance" feedback metric that assures both sides can be counted on to deliver the goods. If a buyer or seller receives a cumulative negative feedback, they may be suspended from participating on eBay. Additionally, a payment service called "PayPal" provides the buyer $1,000 protection on qualified listings and takes care of the payment between buyer and seller. When a buyer registers with the eBay site the following benefits are offered: a personalized shopping page; a place to save searches; notifications of most-wanted items; access to last minute bargains, and PayPal buyer protection (E-Bay, 2005).

Elance is not as well known, but is closer to what the VMM is modeled for. Elance is a buyer's market that presents projects (tasks) and solicits bids from service providers to accomplish those tasks. The idea of a buyer's market is very powerful, it reverses the responsibility of finding products or solution from the buyer to the seller. It is a demand driven market that is similar to what is known in the DOD as a request for proposal. It also offers "performance metrics" of both the purchaser of services and the solution provider. To initiate a project the steps are simple:

- Create a buyer account (1st time buyers only)
- Describe the project; select a service category, set budget, start date and schedule
- Authenticate yourself with a credit card
- Publish your project to the marketplace (invite prospective sellers)
- Receive competitive bids
- Manage the work (Elance, 2005)

Off the shelf solutions can be browsed on Elance. For example if you are looking for a translation of a text, press releases, speeches, or a technical writing, just browse the category writing and translation for service providers. Buyers can read the feedback and selling stats for each of the providers as well. This feedback is critical for buyers who do not have previous business experiences with the providers. The feedback forum provides the earnings report, number of projects accepted and number of feedback reviews. The feedback summary provides a score from 1-5 in six areas: quality of work;

responsiveness; professionalism; subject matter expertise; adherence to cost; and adherence to schedule and a cumulative average. Another way that Elance increases trust between buyer and seller is called a select marketplace, where the buyer is required a deposit to post the project, and select sellers are identified with gold icons behind their listing in the market. Select sellers and buyers behave according to Elance criteria: buyers have minimum bid amounts, sellers have been verified through a trust partner such as *US Search* or *SquareTrade*. These services check service provider's records such as licenses, references, academic degrees, employment history and skill certifications (Elance, 2005). Elance's *Quickstart Guide* that explains how to sell services on the site:

- Service providers register with the site and list the categories of work they provide; they develop profiles in those categories and create optional portfolios of previous work.
- Determine what subscription services they are interested in ranging from: Free Courtesy Elance Yellow Pages listing to Select Professional Package includes all features of Elance
- Service providers then browse submitted projects, using filters based on company capabilities; they can sign up for new project email alerts
- Companies may receive invitations for bids from prospective customers; They place virtual bids.
- Screen Projects-review the buyer's Elance history and feedback on Elance; Clarify the project-post questions on project clarifications board; Communication during the bid process in an Elance Private Message Board
- If a service provider wins the bid, they can then accept the project
- Establish direct communication with the buyer—has optional use of Elance Private Message Board to maintain a written record
- Deliver product through the message board and invoice the buyer through Elance
- Receive payment and withdraw funds from Elance account (Elance Training Manual, 2005).

These procedures and validations provided by eBay and Elance form a virtual environment where trust can be established from long distances, and parties otherwise unrelated can negotiate price and service acceptable to each other. Some of these functions will be very useful in a military market, others will not. Much like eBay, Elance is a marketplace that performs worldwide. The military market model will start

with the Elance template and then translate the features and ideas into its military equivalent--sometimes adding or removing features, sometimes changing approaches to meet the operational requirements of conflict. Several of the features described above will be especially useful in military markets. For example, email or other types of notifications of certain projects that fit the organizations profile, and the invitations to sellers from prospective buyers or brokers to bid. In some cases, the military markets may take advantage of more automated solutions were the operational risk of an information exchange is low, in this case the military market may be set to respond to information needs automatically. Unlike commercial markets were consumers always want to make the final decisions, time to respond in conflict or handling routine mission transactions may be automated where the transaction is just recorded in the market. Another noteworthy observation about successful commercial virtual markets, they provide conditions and trust factors that should be considered when setting up a DOD virtual marketplace.

The next section shows how organizational social network analysis can point the way for market location and illustrate the structure of existing task networks.

D. SOCIAL NETWORK ANALYSIS

The location for military markets may be determined by where the decision making commander sits. A more robust method to validate this would use social network analysis to determine market location, participants, and information flows/needs.

> Social network analysis (SNA) is the mapping and measuring of relationships and flows between people, groups, organizations, animals, computers or other information knowledge processing entities. The nodes in the network are the people and groups while the links show relationships or flows between the nodes. SNA provides both a visual and a mathematical analysis of human relationships (Krebs, 2005).

SNA can be used to study an existing organization and provide a summary of the network connections related to knowledge management, task/process accomplishment, and decision making time. The results of a SNA often reveal connections not reflected in the formal organization chart. Answering such questions as:

- Where are the key decision made?
- Who are the experts?

- Who are the organization's innovators?
- What external links are present?
- What are the internal organizational links?
- What requires leadership interaction?
- Are the right connections in place? (Krebs, 2005)

SNA produce network metrics that can facilitate network optimization. For example finding a node's centrality can help measure the importance of the node, or determine how removed a node is from the main organization. In a market, a node with few connections would probably be a specialist of some sort. Nodes with many connections are often called hubs or connectors. Two other social network measures are betweenness and closeness; both indicate the relative power of the node's location. Betweenness measures control of flows on the network: how many paths go through the node? Closeness describes how quickly one node can reach all others on the network. A high score for control and easy access are good indicators of at least informal power. Finally, for analysis, network capacity refers to the ability to tap any knowledge, skills, and resources of the network (Krebs, 2005).

A SNA of current military tasks and operations is useful to study the network structure of current tasks and C2. SNA provides indicators of where to best place a potential market based on central hubs and communication links. The market location, or actually the links to the market, will ultimately determine how effective and efficient the market will perform. Links to remote capability may be just as valuable as the links to currently engaged forces. The mapping of an organization's normal tasks produces "off the shelf" solutions for task accomplishment. These are usually presented in profile and/or portfolio pages, the organization may present these normal solutions or develop new ones either based on them or from scratch. To develop "off the shelf" solutions, first identify the routine or normal tasks accomplished by the organization. Next, for each task identify the lead on the task, the team membership, resources used, and outside/inside organization connections necessary to complete a task. The creation of off the shelf solutions provides a perspective of an organization's 'as is' operational task network. The network maps can be reviewed for task links, hubs, and decision making

nodes. In this manner SNA can be used to understand current operations and provide indicators of necessary market participants.

E. CONCLUSION

The DOD is just starting to realize that it is time to take advantage of "the other side" of network warfare, the power of distributed knowledge and decision making. Investments in the global information grid, the COP, and other NCO principles have opened up the opportunity to better achieve all of the tenants of NCW. Currently NCO uses the concept of sharing and fusing information, but it does not necessarily taking advantage of the entire network's knowledge or experience. Instead of a few minds working a problem, networks allow the input from various dispersed network users. The idea of exploiting dispersed knowledge or isolated capabilities are rarely considered in the military realm. "Lanes in the road" often keep DOD forces solving problems the same way, based on previous operations and without considering the economies of new approaches. These lanes are often responsible for the lack of new approaches and capability shortfalls as recognized by the Defense Science Board, CCRP and the OFT.

Corporate America has faced its own information age challenges and has started to develop transformational businesses practices that take advantage of disperses knowledge and new virtual business opportunities. Corporations are starting to utilize information pull-orientated processes. In a similar fashion, NCW thus far has utilized its connectivity to push information in vast quantities. This type of information sharing is useful but not entirely efficient or more importantly effective. The information isn't tailored to the individual, situation, or context. Thus, the consumers are left to translate the information and in some cases suffer from information overload. Smart pull of information can be accomplished in a knowledge or information market. In this case the consumer submits specific requirements for information and gets back information from a variety of sources that answer the specific requirement; this is the capability of just one type of market.

An Esquire magazine article about Donald Rumsfeld, outlines a Navy pilot program that plans to test the possibility of an E-Bay type auction system being used in conjunction with the civilian National Security Personnel System. This system would have employees negotiate in web spaces for available jobs (Barnett, 2005). Perhaps the

DOD is starting to scratch the surface of getting things done using alternative C4 structures.

This chapter concludes that both operational requirements are present that can take advantage of internal markets, and that the communication enabled structures are present to make that possible. The rest of this thesis involves applying the concepts covered in this chapter to the military, building a virtual military market model, and walking through a use case that will illustrate how and where internal markets can fit military operations.

Moving on to the question behind this thesis: how can virtual internal markets be used by DOD to improve the solutions and information available for the decision making commander? The reasons for using markets are diverse, but they boil down to effectiveness and efficiencies. Markets have traditionally give strong indicators of resource and capabilities requirements, show resource surplus, indicate the need for new collaborative connections, provide new solutions, and help vanquishing outdated solutions. The new economics of information add greater perspective to market solutions and make them possible in places not previously seen. The next chapter starts to develop a virtual military market model with hopes that the model can be used to test the alternative C4 structures presented in this chapter.

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III. MODEL DEVELOPMENT

How can virtual internal markets be used by the DOD for command, control, collaboration, and coordination (C4)? This chapter develops the elements/components of an internal military market system. The first question to develop the market concept is simple: What are the macro market variables needed for a virtual market? These macro variables help a market builder identify the essential elements required for market formation. The second part of this section presents micro transaction variables; it starts with observations about functional commercial virtual markets, and then starts to translate those observations into the operational military environment.

A. MACRO MARKET VARIABLES AND COMPONENTS

These variables are prerequisites to market creation. These variables need to be developed prior to market development.

1. Identification of Buyers/Consumers and Demand

Markets exist to meet some demand, without demand they will not perform. What is needed by whom? In commercial markets demands range from a consumer's need for products, loans, homes, and entertainment just to name a few. In the commercial world virtual market creation is about identifying a niche market. This is the most essential market component, and the starting point for market development.

Translated in the military, commanders may need information or course of action proposals for operations. Operations personnel also have information and resources needs. Wherever operations are engaged and where decisions and resource allocations are being made are likely market focus points in the military.

After determining the consumers and their demands to be met by a market, other questions follow. Is this a new demand, a niche market? Does this demand need its own market or should it be added to existing market(s)? For example, has a new operation or crisis emerged? What type of market is this? In other words is the demand in the market functionally orientated such as intelligence, operations, or logistics? Or, does the market represent all of these needs and is unique by some discrete geographic or topical demographic? These questions help define the location of the market in virtual

representation. Does it get included as a sub market of an existing market, or does it get listed as a stand alone new market.

2. Identification of Sellers/Solution Providers

Who or what organizations can provide solutions to the demands presented by consumers? Markets should present all possible solution providers available for a particular market. Markets have utility only when individual demands can be met by solution providers available on the market.

3. What is Exchanged?

The virtual military market may involve exchanges of information, data, feedback, and operational solutions. Basic market mechanisms involve the exchange of a statement of requirement from the consumer and a way to present a potential solution and cost basis from a solution provider. Templates are easily constructed in virtual markets for both of these that represent both buyer and seller information.

Identifying the value attached to these exchanges can be as this thesis suggests a cost basis, discussed in more detail later; some sort of point system; or merely an accounting of all resources used. The most important part of the value exchange in a military market is that its scale reflects a comparable measurement between market participants and resources. If the cost basis is not used to determine value, and a point system used in its place, the point value should reflect the level of effort and resources of a given solution and be comparable to other transactions.

4. Determine Incentives for Solution Providers

The buyer has a natural incentive to participate in the market; the buyer needs something. What motivates the seller to meet that need? In the commercial market, that involves a profit motive. Profitability doesn't matter to the DOD; however effective distributed operation capabilities especially for decision making and information sharing does matter. It may be enough incentive to participate with the knowledge that this is how successful operations are achieved. Additional incentives come out of the record and aggregation of all transactions. Here are example incentives for military markets:

Exchange of Cost Basis: A cost basis exchange with a transaction is probably an indirect incentive for participation in a military market. Recording the cost basis for a

transaction doesn't necessarily discriminate one solution from another in a particular transaction, and cost is not necessarily being advocated here as a means for choices between solutions. Few military commanders would use cost to determine their choices in operations. They are more interested in the success of the operation.

Currently, the exchanged cost basis may never equate to dollars for an organization especially outside of DOD, perhaps with changed legislation the cost basis could be exchanged between U.S. government agencies in the future. However, post operations market analysis makes the aggregated summary of transactions in combination with a cost basis extremely useful. Within the DOD this information could be used by decision makers at all levels for determining DOD budgets and billets. Market analysis can prove useful for decisions about weapon systems, and identify the need for new systems in response to EBO needs that couldn't be met exactly. For national agencies, this "score card" could be used differently. The cost basis of whatever is being exchanged is a good starting point to establish a representation of market valuation; this is because perfect markets would exactly relate costs with price (Dixit & Nalebuff, 1991). How to establish a cost basis is determined in market development.

Ratings: How am I doing? Participation in the market helps develop a running total of how well solution providers are doing with feedback and performance indicators. Additionally, these ratings are very valuable to the decision maker when making a choice between solutions to evaluate the risks involved with solution choice. Ratings and feedback can be very useful in assessing a solution for an EBO. Markets can record metrics of how well a solution provider can meet exact effects being prescribed. See Appendix A for additional discussion on military decision making.

Status: I was a participant! The market provides a record of who did what, where, even from remote locations. It tracks contribution and involvement. The question "what have you done for me lately" will be very easily answered for commanders.

These are all either direct or indirect incentives for DOD and outside organizations for participation in virtual military markets.

5. Policy Needs and Broker Roles

Demand drives the military market, and incentives entice solutions for those needs. That doesn't mean that the Laissez-Faire "invisible hand" of Adam Smith's free markets perfectly coordinate these in every situation. Social benefits, for example clean air and safety standards, are often unaccounted for in the commercial markets (Dixit & Nalebuff, 1991). In military markets, this may be the case as well; the good of the entire military effort or specific operation may not be reflected in a singular transaction. In a military market, policy exceptions, rules, and the roles of brokers are important to realize the exceptions of priority, time constraints, operational impacts, and other specific military market needs just as they are used in commercial markets.

History has proved numerous cooperation and coordination mechanisms to meet the collective good and reach John Nash's *Pareto Optimal* solution including: penalties, policy, law enforcement, and contract abatement procedures. One type of market solution is to charge fees or tolls for the "harm" they cause to others in an open market. They are often "innocuous" enough, such as the rate of a toll road. In this case time and money are traded based on a common value basis between the commuter participants who choose between driving and public transit (Dixit & Nalebuff., 1991).

Brokers in markets help establish relationships between consumers and solution providers. Their roles may vary, however they are often a critical intermediary between two parties, and are often the source of introduction between them. Brokers in the commercial world are often licensed in their area of expertise. The roles of brokers in the military market are similar to those roles in the commercial market. Brokers may be tied to organizations, but their most valuable responsibility is to increase the number of successful transactions between buyer and seller. Specifically, brokers often facilitate transactions that otherwise would not happen based on buyer or seller awareness. Brokers in both the commercial and military markets should be effective users of social network analysis; this combined with their specialty market expertise makes their roles indispensable and key to market success. Market developers need to consider broker roles and skill sets carefully market by market.

The situations requiring policy or broker actions should be thought through for each military market during development. These roles need to be further refined during experimentation or exercise. In many cases, specifying the roles of brokers and their locations in the market can mitigate these issues. In other cases, establishing a market policy to handle all such situations may be effective. These policies and broker roles are important macro considerations and are implemented in micro transaction considerations. Examples of policies and broker roles are illustrated in the intelligence use case.

6. Assumptions for Virtual Market Creation

One basic assumption for the creation of a virtual market is access; in the case of a DOD command and control or intelligence markets this requires access to SIPRNET. For coalition environments, access is usually on a coalition network. Another assumption that is part of market development is the improvement over other control and collaboration exchange mechanisms. Assumptions about improvements are made at the macro level, and usually evaluated during model testing. The measurable improvements of market mechanisms over traditional collaboration, control, and exchange mechanisms are very important to the consideration of virtual military markets.

7. Summary

These are the virtual market essential considerations and macro variables. Markets do not exist without each of these. The next section illustrates the details that create functional virtual market transaction spaces. It is important emphasize that when the macro variables of consumer, solution provider, identification of exchange and incentive for exchange are met, a market mechanism can solve the problem. It is then just a matter of developing the transaction space.

B. MICRO VARIABLE DEVELOPMENT

This thesis uses the virtual market transaction space of Elance to begin to identify how to develop a DOD market, the idea being to not reinvent what already exists but to apply subtle changes to existing business models. The Elance market offers numerous market components and variables, for example description of project, time for completion, performance ratings, competitive bids, project management participants, and others. The following analysis presents DOD equivalents of these variables, discusses

their relationship to Elance where applicable, and determines what type of modeling or simulation is required for the individual market components.

1. Statement of Requirement (Demand)

Markets are demand driven, so what is needed from the market space? In the Elance marketplace this is called posting a project. Three types of needs are discussed here that are present in an operational military environment (by no means an exhaustive list of military requirements). In each case a requirement template is developed to capture the requirement. For the Joint Force Commander, one requirement is a solution for an effects based operation (EBO), another is an operational information requirement. The last requirement discussed here is an unplanned requirement during operations.

- Effects Based Operations (EBO) -- this type requirement will be involved in campaign planning and operations where a normal planning cycle is accomplished. EBO is a complicated consideration of actions, coordination, ripple effects and cascades (Smith, 2004). For the purpose of this model, it will be assumed that a requirement has undergone full EBO analysis and has enough detail to be accomplished.

- Information requirement-- information needs (intelligence) can be part of operational planning or unplanned intelligence requirements as operations proceed. In the unplanned case the need is usually described by the operations personnel. Information needs can be recurring in several ways: as automatic updates (daily products or analysis updates or changes), flags when updates are available, or for access to a database.

- Unplanned requirements during operation-- these types of requirements emerge during the operation and are considered unplanned. These requirements can be as simple as additional equipment requirements-- to a call for unplanned close air support, firepower, or troop deployments.

These types of requirements drive the market and represent the single most important reason for creating internal DOD markets. In other places this is called a demand driven network. Some decision theory can be used to determine estimates of success for decision makers. This type of analysis provides the basis for determining

what should be asked for in the requirement template. See appendix A for a full discussion of decision theory contribution to the market model. It is assumed that the requirements presented to the market reflect actual operational needs and meet the scrutiny of commander's intent.

2. Market Templates and Negotiation Space

Each market must have useful templates for the consumer and solution provider respectively. Elance and other commercial markets offer generic requirement templates; they also offer instruction on how to best state requirements that achieve the clearest results and provide examples. Further requirement refinements are worked out in negotiations between the market participants after they are introduced usually in a virtual workspace. This type of workspace is also used to keep track of solution progress.

In the virtual military market these templates need to capture all of the essential components of requirements and carry them through the market process from presentation of a new requirement through completion of the operation. Requirement refinements from negotiations should also be captured in historical template information. Solution templates should capture the information needed by the decision maker to make a choice among alternatives.

3. Cost Basis or Other Value Determination

In the Elance environment, potential service providers are asked to place bids on posted projects. This bid reflects the value of time spent and resources used by a service provider solution in a competitive environment. This may be simplified in the military market. It would be difficult and cumbersome for a commander to attempt to state the sum of the costs of an operation that includes the costs of manpower, knowledge, equipment, sustainment, logistics, etc. In the military market, the value of the transaction should equate to the cost basis of the information and resources used based on DOD approved resource tables. The cost basis is automatically generated with the bid based on the relevant resources and time estimated by the solution provider and submitted with the bid. Since perfect markets equate cost with price, using the cost basis as the transaction price is a simple valuation method. In this way the cost basis is consistent throughout the market and changes only because of capacity and priority issues discussed later.

This cost basis relies on the accuracy of tables of values that represent the cost of the resources presented for the operation. This cost basis submodel utilizes a "cost per resource hour" table of costs. The value for the solution is automatically calculated with solution submission to the market and not proposed by the solution provider. For operational packages, the cost basis for personnel, equipment, and resources are reflected on the proposal. Then their value is taken from tables stating the hourly employment cost of each resource. For a solution that requires 12 people, 2 tanks, a certain command and control package, and 6 hours to complete, the market cost module consults DOD tables to retrieve the cost of each stated resource for six hours. A unit's "off the shelf" solution has a predetermined cost basis when employed "as is", and should be posted on the unit's portfolio page.

The cost basis is automatically attached with all bids on the market, and is included in the final approved transaction based on the solution provider's estimate of the amount of time, weapon system, other equipment, time, etc. The cost basis is unlikely to contribute to solution selection; however that is up to the decision making commander. Perhaps the cost basis may become more important in the case of two solutions that have equivalent expected value or risk associated with them. See discussion in Appendix A. As mentioned before this cost basis is more important to post market analysis than to individual operational decisions.

In a similar manner the cost basis of information (intelligence) is from an established table of values, determined by the information source provider and within the global cost structure of the assets used. For example all satellite imagery should cost a generic average price in the market for simplicity, except where the conditions warrant. In some cases the use of commercial imagery may be cheaper than that of national assets, the satellite used may be an exceptionally expensive system, or in some cases less costly such as TacSat assets (OFT, 2004B).

An information solution provider will list their standard product prices on their profile portfolio page. Every time a user gets a particular report, picture, or other analysis this is the cost assessed for the transaction. The cost basis for a tailored report or analysis

will be presented by the solution provider by estimating analyst time and resources used much like an operational solution does.

4. Performance Ratings

Elance offers a six part rating scale described in chapter three of this thesis. Elance also presents a running dollar total of the company's historical transactions over time, which is a good indicator of the demand for that organization's solutions. Recording demand will be important in the military model

Various measures are possible in military markets to show performance. The most important measures of performance provide the decision making commander relevant information that helps in future decision making. Four types of feedback criteria are discussed here; these are by no means complete list. Additional ideas about performance metrics and how to improve commander's decision criteria are presented in Appendix A.

Here are examples of possible feedback criteria: EBO achievement or need fulfillment, an after-action comparison of the total cost basis of all the resources employed compared with those presented in the proposal, the ability to execute on schedule or adjust to operational changes, and the ability to resolve conflict and accomplish risk mitigation.

- **Achievement of Effects Based Operations**: Was the objective attained? In the Elance world the buyer either received a project the way they wanted it accomplished or not. This is reflected in the feedback. This model needs to establish a metric that represents the attainment of the objective, or the meeting of an information requirement. It may do this by individual attributes involved in the solution.

- **Meeting Cost Basis Estimates**: Was the product or operational solution presented reasonably? Very similar to Elance's adherence to cost, were more or fewer resources used than expected? This metric rates the unit's ability to present accurate estimates of required resources needed for operations. Post operation analysis would compare the actual operation with the estimated

operation provided by the solution provider. This metric informs the operational commander just how well a unit can estimate its activities.

- **Schedule adherence**: Was the operation executed on schedule? Elance has a metric for the project meeting its schedule. In a similar fashion a military operation can be measured. However, adaptability is also an important quality for military employment in the fog and friction of war. It may be necessary to alter schedules to meet operational changes. This needs to be considered in this metric as well.

- **Conflict and risk mitigation**: Was the task completed without creating conflicts with other employed forces in a synergistic and force multiplying way? This metric is unique to the military. Projects that are accomplished on Elance are generally stand-alone, "turn key" projects. However, military operations are undertaken during continuing operation and need to be coordinated and deconflicted with other military units and/or other agencies. This category may be broken into a couple of metrics depending on specific mission attributes, and the unit's ability to accurately present their risk for each of these. See Appendix A for more discussion on this.

Experimentation and/or simulation should help determine if a cumulative average should be established between these ratings or some sort of weighted accumulative score. In other words, are all of these factors equivalent? The Elance model treats their metrics equally with a cumulative average. How performance is measured is important feature of the market. Additionally, some consideration about the entry performance rating of new solution providers needs to be determined. Simulation and or experimentation should be used to explore the performance factor of new solution providers entering the market. Specific markets, and even specific solutions types may have different measures of performance and feedback. It is important to maintain some level of equivalence about these measures so that they may be compared across the market.

Feedback and performance measures are central to the improvement of the information for the decision maker and therefore require careful consideration when being developed for a market. The measures involved in determining performance

should in no way be arbitrary, generic, or treated lightly by consumers or solution providers. The market developer should consider the prerequisites of improved information for the decision maker and develop metrics that reflect this. Consumers must understand that feedback does exactly that; their measures of performance and feedback provide other decision makers with estimations of how much trust and confidence they can expect of solution providers. A scale of these quality measures needs to be predefined and used consistently in markets. For example, a timeliness metric that measures the "on-time" delivery of a solution is shown in Table 1:

Table 1. Scale of Performance- Timeliness

Measure	Quality measures of timeliness
(5) Perfect	On-time
(4) Good	Within a (pre-defined % time) with no mission/effort impact
(3) Fair	Outside of (pre-defined % time) with no mission/effort impact
(2) Poor	Delayed mission or effort
(1) Inferior	Caused mission/effort degradation or failure

Quality feedback provides the decision making commanders with performance measures that tell them something about the solutions presented to them. These performance metrics need to be carefully considered and written feedback should reflect the "why" of the rating. One way to get all solution providers closer to "perfect" is through mission effects/impact feedback mechanisms. These measures increase confidence in decision making and distributed operations.

5. Time

Time is a complex variable and market response may depend on the amount of information technology being used in the market. For example, the Sense and Respond Logistics concept uses autonomous "agents" to initiate market transactions. Time to respond may determine the limit of market mechanisms. Certainly during "under fire" circumstances, markets may not meet the need for addition firepower. Just how fast can the market respond: days, hours, minutes? This must be determined for each type of military market developed. Time shouldn't be a factor when using market for planning.

Time requirements for operational markets are somewhere between "must have it now" and "must have it when required".

Two measures of time that need to be captured in market requirements are time for proposals (bids) and time for solution delivery. The ability to meet the proposal time may be a constraint of market mechanism use. This variable should be refined, developed, and tested in simulation and exercises. Real measures of timeliness and constraints should be developed for each market.

6. Brokers

The knowledge network and the effectiveness and placement of the broker within the market will contribute measurably to improved command decision making and are critical for model employment. The broker's knowledge will not be considered a measurable factor (or numerically represented) in model development, but should be considered when the model reaches experimentation or exercise. Specific roles of brokers should be developed during model creation and experimented with during exercises. As mentioned earlier, brokers may meet some of the policy needs of a market especially in matters of priority and time constraints. The capabilities of brokers could influence the market significantly and should be experimented with in joint exercises and developed as a new acumen in the DOD. In many cases broker roles supplant many layers of bureaucracy present in today's command, control, communication processes.

7. Market Participation and Location

The Elance market is a ubiquitous market that allows participation by all registered buyers and subscription-paying solution providers that have access to the Internet. Virtual commercial markets are established by creating a type of market (buyer/seller) and creating specific categories of service or product.

These are very important considerations for virtual military markets. Should all markets participate on one global website, with subcategories based on geographic location or type of operation? Wherever possible, the virtual military markets should be in one transaction space like their commercial equivalents because this allows for ease of use and access. The commander, analyst, solution provider, etc. should have everything available to them in one location.

Intelligence markets present classification difficulties. One possible solution is to have the virtual military market resident on SIPRNET and record all transactions there. However, the actual information exchange may need to take place on a different classified network. This would be equivalent to choosing between the Post Office and FedEx for product delivery and can be handled the same way. Where this isn't possible with a digital process, human actions are called upon.

For the purpose of developing an initial market model, one market transaction space is assumed; all possible solution providers will have visibility of all resources and requirements in the market. It is also assumed that all data exchanges will be accomplished at the same classification as the transaction space. These assumptions can be refined as markets reach mature development.

8. Unit Profiles

In Elance a buyer can survey a list of service provider portfolios and solutions that are available in the market. This often helps the buyer describe their project more clearly. Elance profile pages provide service "templates" that outline the requirements statements to help buyers prepare a request for the particular requirement.

In the military market, profiles will contain operational "category" information about a unit and or a unit's products in the case of an intelligence organization. This will facilitate quick searches for unit type and capabilities. If a commander is looking for a particular air package participating in his market, a quick search of air assets will reveal those that are participating. In the case of an Intel market, the profile reflects the types of information available from the provider and taskable assets.

A unit's "off the shelf" solutions should be included in their profile as portfolio items. For example, an F-15 Squadron can provide a list of standard packages that it flies with. The Squadron's "off the shelf solutions", include the number of airplanes, all personnel involved (including ground personnel necessary for the operation), command and control and other system requirements (such as average Air Operation Center planning time required, AWACS use, special comms, etc.). The off the shelf solutions would be described briefly and their cost basis would be listed in the portfolio. Tailored

packages would be built from these generic solutions or developed from scratch when the situation is warranted.

9. Resource and Unit Availability

When a solution is presented in Elance, the buyer makes an assumption that the solution provider is available to provide the solution that was presented. This is a self synchronization characteristic of markets. This will be a military market assumption; the resources being presented are available for the operation at the proposed operation time and they are not being over utilized. Demand and capacity counts should be used to monitor these behaviors in the military market for better decision making and to account for policy exceptions such as priority queuing rules and time sensitive requirements.

At the same time, in the Elance market, the buyer is hopeful that a variety of solution providers present choices for the buyers needs. The Elance market doesn't really care if a particular solution provider doesn't participate. In the case that a solution is not presented during the bid cycle, the buyer's needs will either have to be restated, individual solution providers may be solicited to bid, or the need remains unmet.

The military market can use more traditional C2 relationships to assure that needs are met and that all solution providers are involved; broker roles can facilitate these needs. However, such important market information such as lack of solution or availability should be handled by either changing market participation to increase resources, or finding new solutions to meet the needs. This is where a talented broker can leverage their social and knowledge networks to invite new market participants or solicit new solutions from current participants. This type of market information can be successfully used to evolve capabilities and establish self adjusting utilization metrics.

10. Special Considerations

After developing the market transaction space and mechanisms, it is important to consider what organizations and/or resources that may not do well in the market. In these cases the market can reflect those demands in different ways or decision makers can acknowledge that these items are exceptions. One case of a military asset that wouldn't show high demand are nuclear weapons. Thankfully, we haven't used many of these.

Another type of special case is how much visibility to allow of a market, asset, requirement or solution. In some cases some assets or requirements may need to be seen by only specific users. Market visibility is a consideration for almost all markets. Operational markets may only be visible to assigned or invited individuals or organizations and DOD senior leadership.

C. ESTIMATES OF IMPROVED DECISION MAKING

Every virtual market that is created should be developed with this goal in mind. During market conception, estimates of specific improvements should be made. Then during development and testing these estimates should be found valid or not.

1. Market Mechanisms Work Together

The interaction between bid prices and a performance factor is a critical relationship to understand in the Elance market. In commercial markets a buyer deciding between service providers makes a choice based on the price presented and the performance factors. The individual buyer determines if the risk of accepting a solution that costs less but has poor feedback than that of a higher bidder with better feedback. The interaction between these two variables creates a market decision. This is where trust is essential; market mechanisms should help produce a decision basis.

In the military market, a decision is usually made based on probability of an operation's success. The cost basis is not usually part of decision making for the most part in the military market. However, the commander is interested in having the best possible course of action for a given problem. Specific market mechanisms should be developed and employed based on the decision making strategy of the commander. These market mechanisms range from how the commander presents a requirement, to how a solution provider presents a solution and is rated on performance. This market model is useful because the mechanisms can be increasingly refined to produce the type of information that is needed for effective decision making. For more discussion on EBO decision making see appendix A.

2. Post Operations and Transaction Analysis

The improvement of decision making information for the operational commander is measured by the quality of information made available for operational decision making. The second layer of improved decision making may be for force structure

decisions. This thesis has not developed virtual military market analysis or error checking tools; however the aggregate of all of the transaction in a market can provide DOD senior leadership with excellent indications of asset value, the need for new capabilities, or shortages of existing resources. Borrowing from commercial analysis, indexing and indicators can lead to value added decision making well above the operational level. Determining how to deal with such market indicators will require strategic level decision makers to facilitate the changes needed. This type of decision making isn't simulated in the market model, but should be considered in new CONOPs, development of strategy, and for future study.

D. CONCLUSION

The complete market model needs to perform well to be considered for use in real-world military operations. This is where both the principles of model development and the standards of new transformational concepts like *Power to the Edge* must be met. The market must self synchronize, produce solutions that make sense, work in coalition environments, employ an appropriate means to respond, and orchestrate the means to respond in a timely manner. These essential criteria create trust in market decision making and therefore make it useful for military operations.

This chapter has presented the macro variable and many of the micro transaction variables required to develop a virtual military market. The next chapter walks through this model and presents an intelligence use case.

IV. INTELLIGENCE USE CASE

This chapter takes the market model presented in the last chapter and applies it to the DOD intelligence process. The Virtual Military Intelligence Market (VMIM) discussed here illustrates the consideration taken for the macro variables and micro transaction processes that are required to establish a virtual military market. Why use the virtual military market for intelligence? Or a more specific question, how does a market improve the intelligence process? This is a fair question from intelligence professionals. This section addresses the application of the market model for the intelligence process, and presents measurable improvements for validation. This use case takes market development through the steps of problem identification, assumption development, and market model development/interpretation for the intelligence process. The last three steps of model development-- verification, implementation, and maintenance of the market model are not completed in this thesis.

A. STATEMENT OF THE PROBLEM

> 'I could probably get more usable intelligence from a séance,' quips one officer with recent Iraq experience.
>
> 'The intelligence community is so layered and so compartmentalized that the only secrets they keep are from themselves,' says one Marine officer who has served in Iraq, speaking only somewhat in jest (Grossman, 2005).

The intelligence community has a fair share of critics ranging from Congress to operational troops on the ground. Expressions of intelligence deficiencies are pervasive. The 9/11 report summarizes two primary needs for the intelligence community: the need for the community to restructure, and to increase information sharing with incentives (2004). The following themes are found in most criticisms of the intelligence community: stop hording, change what is valued by the community, and change the culture from "need to know" to "need to share." Mark Lowenthal presents the following additional recommendations:

- Create measures that show efficient analysis, collection, and operations support
- Changed transactions processes & structures to meet the goal of agility

- Access to value added expertise that is flexible and has surge analyst capacity
- Improved requirements process
- Creation of intelligence reserve for crises
- Properly balance redundancy and duplication for competitive analysis (Lowenthal, 2003)

Similar changes to intelligence are needed at the operation level and for counterinsurgency. Various authors recommend other intelligence reforms including: intelligence sharing out of stovepipes and increased focus on to attaining timely and relevant HUMINT information; intelligence officers need to increase their social network skills and establish relationships with counterparts in other organizations; and competing and alternative hypothesis need more consideration (Grau, 2004). New intelligence structures are also called for that consider the protracted nature of counterinsurgency, and essentially become a global "network of networks" where all nodes are users and producers of intelligence (Sullivan & Bunker, 2002).

Major General Scales (retired) offers the following lessons learned from Afghanistan: the need for better culturally centric HUMINT and better "actionable" intelligence post kinetic phase. Scales recommends changing the focus of the intelligence community to the tactical operator, as well as pushing intelligence collection and analysis downward or closer to the tactical operator, and the creation of global scout experts with area expertise (2004).

The question that needs to be asked for the development of a military intelligence market is: Can a virtual military intelligence market improve the intelligence process of today and start to address some of these concerns? The following improvements are presented as testable hypotheses for the intelligence use case:

- Increase focus on the intelligence consumer and provide tailored analysis for operational needs
- Provide a common process and language for community transactions
- Create a "one stop shop" for consumers & analysts for all intelligence transactions

- Provide incentives that improve intelligence sharing and collaboration and change intelligence community focus to “need to share” to meet consumer demands
- Provide qualitative measures of effectiveness
- Increase the incentives for competitive analysis and alternative hypothesis
- Routinize data management & validation from operational and HUMINT sources
- Increase awareness of organizational and community capabilities and skills
- Better prioritize intelligence requirements globally, regionally and locally
- Utilize otherwise unused analysis capabilities (spare capacity)
- Reach remote specialized skills and analysis
- Provide a common transaction space for multi – intelligence products
- Provide a single process for crisis and routine intelligence requirements that has reach to the entire intelligence community

All of these ultimately lead to improvement in the quality of information available for the decision making commander. The bottom line reason to develop the VMIM transaction space is that it adds value and can start to change the intelligence community today. To better see how, the remaining portion of this chapter walks through the market model.

Keep in mind that this market model doesn’t change the organizations involved in the market either by their organization designs or their current business processes. Instead the VMIM provides a transaction space between organizations that is specifically focused on stating and answering intelligence requirements of intelligence consumers wherever they maybe. The internal workings of an organization are left to their own efficiencies and business processes.

B. INTELLIGENCE MARKET MACRO VARIABLES

These are the essential variable required to start to think about the intelligence market. Each market needs to identify these components. What are the needs, who are the consumers and solution providers? What is exchanged in the virtual market and what are the incentives for participation? Figure 1 represents the top level of the VMIM.

Figure 1. Virtual Military Intelligence Market

1. Buyers/Consumers and Demand

The consumers in the intelligence process and the VMIM include commanders, operational personnel, and military planners. Depending on their specific task, analysts and collection managers may fill the role of consumers as well. Each of these consumers has specific demands for the VMIM-- ranging from intelligence analysis, raw data, asset/resource time and current operational situational awareness including: battle damage assessment, country studies, target identification, and adhoc field operational debriefs to name a few. The commander's information requirements about the battlefield or adversary largely drive the intelligence market.

2. Sellers/Solution Providers

The solution providers include all of the production organizations and asset owners involved in U.S. intelligence. Table 1 summarizes these. Additional solution providers for the VMIM are fielded operational forces and HUMINT networks in forward locations. Each of these sources can provide valuable information and/or analysis for stated intelligence requirement.

Table 2. Intelligence Solution Providers (JP 2-01, 2004)

• Service Intelligence Organizations--Air Force, Army, Navy, Marine Corps	• (NGA) National Geospatial-Intelligence Agency
• (NSA) National Security Agency	• (CIA) Central Intelligence Agency
• (NRO) National Reconnaissance Office	• (DOS) Department of State
• (DIA) Defense Intelligence Agency	• (FBI) Federal Bureau of Investigations
• (DOT) Department of Treasury	• (DOE) Department of Energy
• (NMJIC) National Military Joint Intelligence Center	• Combatant Commander's (JIC) Joint Intelligence Centers
• Department of Homeland Security	(JP 2-01, 2004)

3. Exchanges

There are a variety of exchanges involved in the intelligence process today, and market mechanism can facilitate most of them. Intelligence requirements are met with solutions consisting of either raw data or analyzed products of various types from the assets and production organizations mentioned above. Examples of intelligence include:

- (SIGINT) signals intelligence
- (IMINT) imagery intelligence
- (HUMINT) human intelligence
- (MASINT) measurement and signature intelligence
- (OSINT) open-source intelligence
- (TECHINT) technical intelligence
- (CI) counterintelligence
- (MULTINT) multiple intelligence product (JP 2-0, 2000).

In addition to intelligence products, the VMIM exchanges feedback and performance/quality metrics for all products and databases. The VMIM also records a value for the transaction (cost basis or point system), and reflects the preferences of consumers for tailored or routine products in requirement templates.

4. Incentives

As mentioned in the model development chapter, the use of a cost basis or other value basis in the exchange phase of a transaction, may never equate to dollars (or profit) for participating organizations. Today, U.S. legislation restricts exchanges of money/budgets between the departments. However, with changed legislation, a yearly exchange of accumulated costs recorded on a market between departments, such as the CIA and DOD, would be a powerful indirect incentive for outside organizations to participate in the military market. Today these measures could definitely be used by

decision makers at all levels for determining budgets and billets within the DOD. Additionally, under today's laws, this department and agency score card could be used by U.S. policymakers to help determine department and agency budgets. When an organization is judged not for the secrets that they hold, but instead by the demand for and quality of actionable intelligence they provide warfighters and policymakers, this meaningful change in community focus provides ample incentive to participate.

At the operational level, motivation to get quality information to the decision maker hardly needs an incentive; the knowledge that the market presents the transaction space to meet almost all intelligence needs may be enough. The common transaction space of the VMIM should provide a user friendly environment for both consumer and solution provider. Other incentives to participate in the VMIM include the record of all transactions and a means of providing the intelligence community qualitative feedback measures by organization. Market transactions are recorded down to the analyst level and thus also provide individual performance and contribution measures of effectiveness. This will prove to be very important for future personnel performance based systems being considered by the DOD (Barnett, 2005).

5. Market Policy and Broker Needs

Both market policies and brokers are essential for the VMIM. The policy and broker needs that were apparent during use case development are presented as they occur in the micro transaction sections that follow. One important market policy for consideration in the intelligence market is a consideration of the "monetary" policy. This thesis hasn't created a budget for the consumer to be constrained or limited by. The effort is to get as much information to the decision making commander as possible and that is wanted. This policy may have the result of over tasking market assets, since the consumer may accept all, some or none of the solutions presented in the market. However, since organizations are submitting solution proposals for requirements, the market assumes that the solution provider has the ability to produce and is within its capacity. Some artificially high capacities may result from the lack of economic constraints on the consumer. This is an example of a market policy that should be experimented with, but caution should be used when considering limitations on operational intelligence consumption. The profile pages should show capacities of the

participating market organizations being represented such as the OIF Intelligence Market in Figure 2.

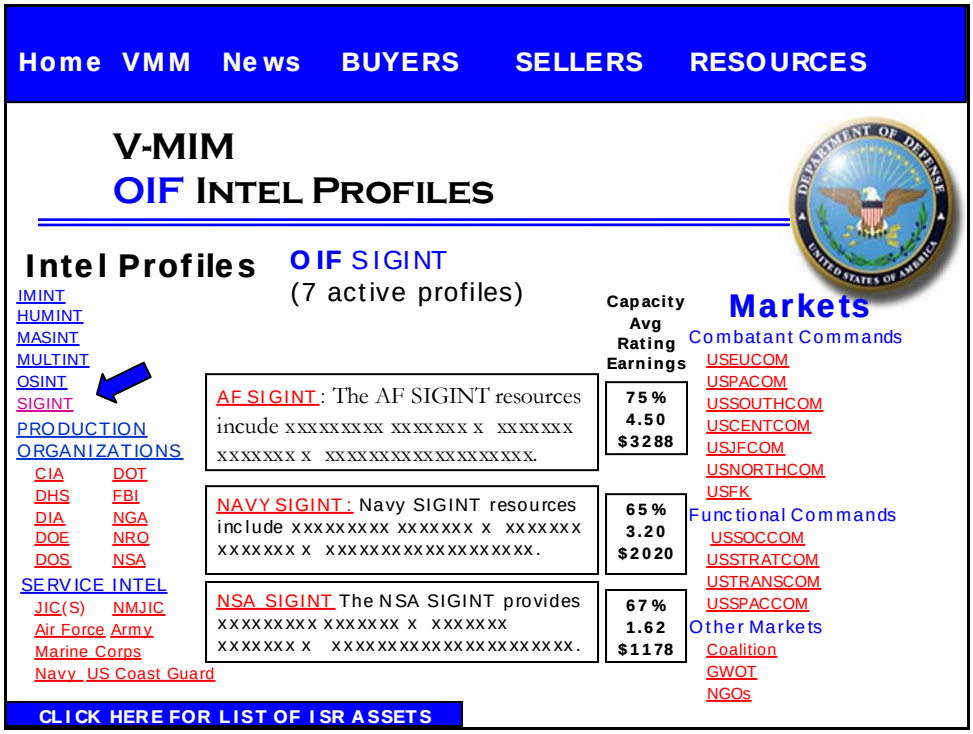

Figure 2. VMIM Profile Pages

B. INTELLIGENCE MARKET MICRO VARIABLES

This section develops the transaction space for the VMIM. These variables are specifically designed to capture requirements and present solutions in the most effective way possible. This should be kept in mind during market development.

1. Statement of Requirement (Demand)

Here are a few examples of demands that are presented by commanders, analysts, collection managers, and operational participants of the VMIM.

- Priority intelligence requirement
- Requests for information (RFI)
- Battle damage assessment
- Raw data – images, signals, etc
- Asset tasking

The more descriptive and specific the request provided to the VMIM, the better the market response can be. One VMIM market policy may have requirement validation/quality validation by brokers when an intelligence officer is not associated with the operational unit stating the requirement. This is an easy requirement quality check to be accomplished, for example by a JIC broker, to assure that the requirement is properly stated and facilitated. Example requirement templates can help achieve this.

Tasking of assets today is a tightly controlled process. However, as demonstrated by the Office of Force Transformation's Operationally Responsive Space Experiment TacSat-1, perhaps direct asset tasking at the Joint Task Force level is not so unimaginable (OFT, 2005B). Today, one such asset is subject to tactical SIPRNET control and dissemination of both its infrared and visible imagery. The market would utilize a similar brokered mechanism to reach assets not normally associated with a particular operation.

A commander's request for battlespace awareness is a request for a wide range of information that, in many cases, operational debriefs can help fulfill. These types of requirements are not typical of commercial markets, but are important in the battlespace. By using the idea that every person is a sensor, additional information can be quickly added to the common operational and intelligence picture of an operation. In the past such information has flowed through chat sessions. However, this information can and has proved to result in incidents of fratricide because the information wasn't validated against the current intelligence or operational picture. The market should formalize a process for getting that data into the market and provide a validation process for it.

2. Market Templates

VMIM requirement templates are critical to capturing intelligence needs. The template must capture what the consumer/buyer, the commander, needs from the market to get the mission accomplished. The goal is to get better information to the decision maker. The requirement template is similar to those in current use, but tailored to best reflect consumer needs. Important worksheet features include a space for an operation identifier, priority, and time elements. These tie the requirement to operations, and start to establish baseline metric data.

Figure 3 is an example online form. This template shows the required fields by selected intelligence category; this is an example of an IMINT template.

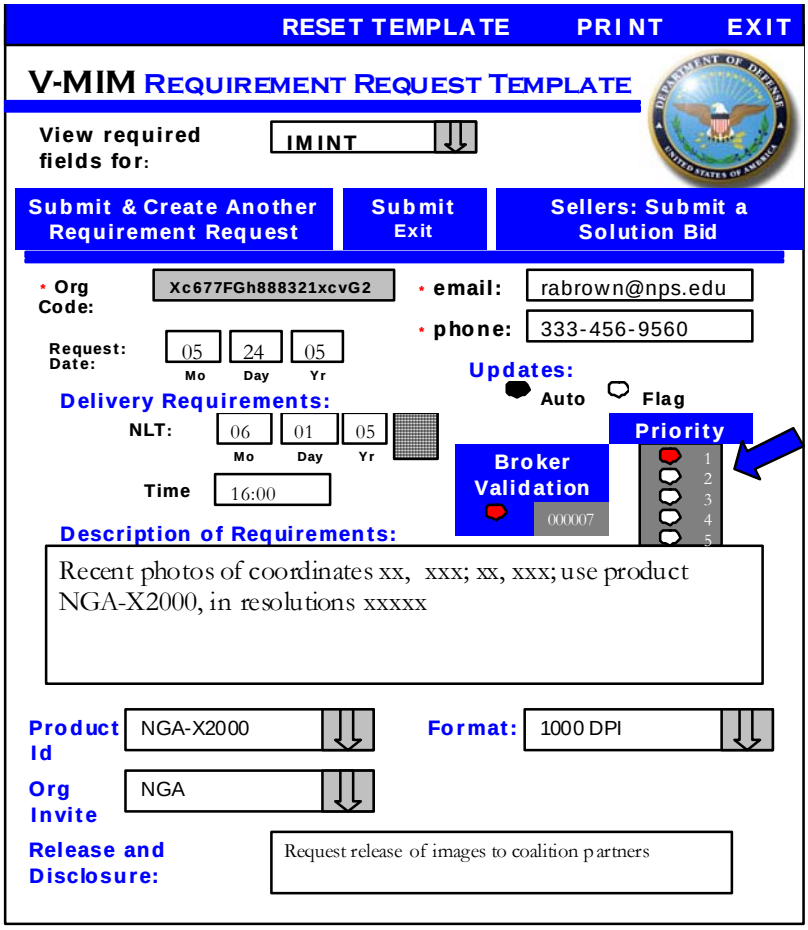

Figure 3. Example VMIM Requirement Template

When a consumer fills it out, his organization and contact information are automatically filled in, as well as the operation he is involved with and request date. The request date is kept updated until submitted to the market. The consumer fills in the "no later than" delivery time, and delivery instructions. Another network may need to be used to actually exchange the data; this is much the same as choosing between FEDEX and US Mail for delivery. Consumers can select to receive automatic or flagged updates.

The template allows a consumer select a priority for the requirement where priority 3 is a normal priority. Priority 2- high, or priority 1- life or death, require validation by the market broker responsible for the market in question and will receive preferential treatment and close monitoring by brokers and solution providers. Reserving

this type of activity and preferential treatment to these very critical priorities will assure that the market can respond well to the situation where time matters to the operator.

The requirement template submitted to the market becomes the "in process" template that is seen in the market place. At this point, the template needs to have a status section showing any required validations, indicate which organizations are working on solutions proposals and/or negotiating (refining) the requirement with the consumer. Bottom line the in process requirement should have as much information about efforts to solve the requirement as possible.

Solution providers fill in their solution information on a proposal template. The proposal should capture (or link to) all previous information about the requirement. The consumer of the intelligence market may select all, some, or none of the solutions presented by the market by selecting "accept" on the solution template they receive. This then goes back to the solution organization(s) and they start working from the solution template. The solution template should record all sources and additional transactions completed by the organization to accomplish the requirement. Eventually this solution template and final product are sent back to the requestor. As a market policy, the visibility of the solution template should probably remain hidden (to those outside the tasked solution organization) until the organization has approved its release. The "in process" requirement template could show a progress indicator (by organization if multiple organization's are responding) that can be seen by the consumer and market.

Subscription type information requirement templates can be used to enable pull access to databases and pushed intelligence products. The organic databases in the VMIM would have a yearly subscription rate access to the databases. In the case of a routine product distribution (such as a daily brief) that is not posted to a database, the consumer fills out a requirement template for a particular report and or topic to automatically receive updates or routine product distribution from an organization. The organizations that have these products should list them in their profile page, and offer a subscription link for them.

Another important template that should be developed is a field data and operations debrief template to facilitate the exchange of our own field operator

HUMINT. This information would go, among other places, into one of the VMIM's organic HUMINT databases – a field data repository. An operations debrief template is developed that offers a selection of formats from a pull down menu (for example aircrew or operational unit post mission HUMINT report). This information would be filled in by a debriefer or operations personnel, and depending on market rules, the information would be routed to brokers for validation and release to the field debrief database for better battlefield situational awareness. The operator & broker may flag the priority of the information to show up in "hot" topics for the operational and intelligence markets.

The VMIM can offer a variety of means to negotiate or further define requirements, and monitor solution progress. This can be done in a workspace associated with the requirement template or by phone calls, chat rooms, etc. What is important is that the history of requirement negotiation is recorded in the template to reflect requirement refinement and changes.

3. Cost Basis or Value Determination

Every intelligence product or database access should have a published or derived cost for its use. For most products, this should include the raw data costs and analyst time costs. For example, access to databases (pull capability) can be given for a yearly subscription or a sub-time frame like a quarterly or monthly cost. Database subscriptions are calculated by totaling the yearly cost of the database (system, estimated analyst time, and raw data costs) and then dividing by a certain number of expected subscriptions as illustrated in Figure 4. This will essentially "recover" the database cost basis over a timeframe and provide a market value of database information and analysis.

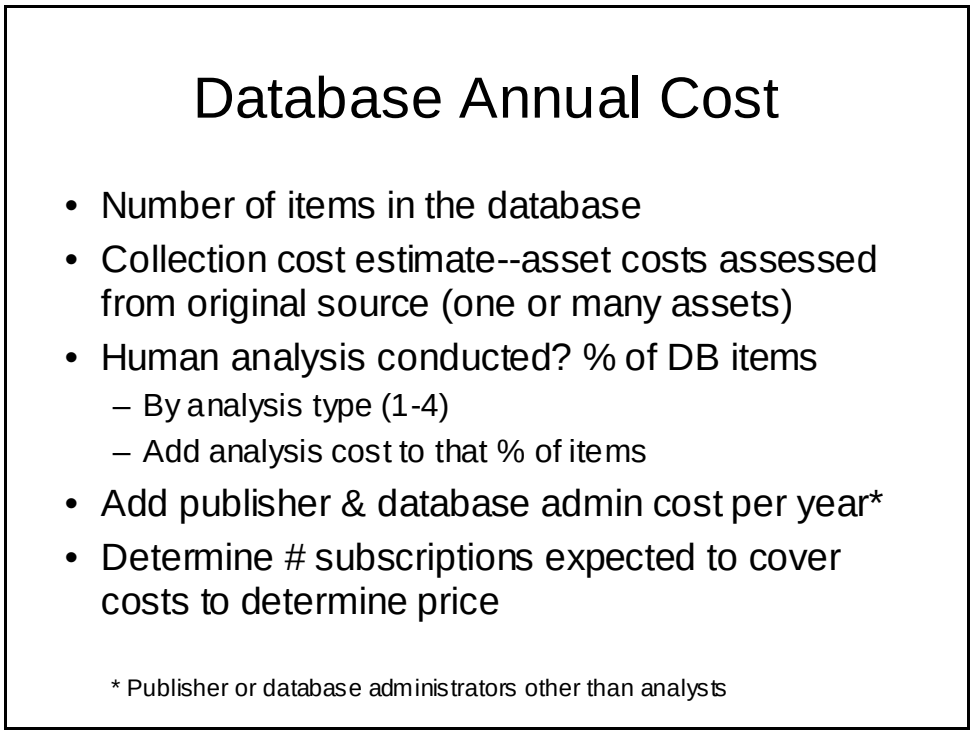

Figure 4. Example of Database Cost Basis Determination

Raw data costs are derived from either a portion of a subscription rate to a large database, or the published cost of a specifically tasked asset. In the case of a satellite specifically tasked to provide images to meet an intelligence requirement, that asset will have an advertised per image cost, as established in DOD cost basis tables.

Analyst time can be calculated as an average. In the course of this research, intelligence analysts suggested that capturing analyst time used in less than one-hour increments would not be a useful record in the design of the VMIM. This probably needs further discussion. However, setting up a scale of analysis-- an example of which is shown in Figure 5**,** can capture enough detail to establish initial VMIM value. The VMIM is not looking to capture exact detail of the hours and cost of every analyst from junior grade to the most senior grade that were involved in the production and approval of a product within an organization. Instead, establishing a representative scale of the order of magnitude of effort that the organization expects to use in their solution may be more useful. With this method, an organization presents an analyst solution to a RFI with an estimated scale of analysis and raw data rather than a more "precise guess".

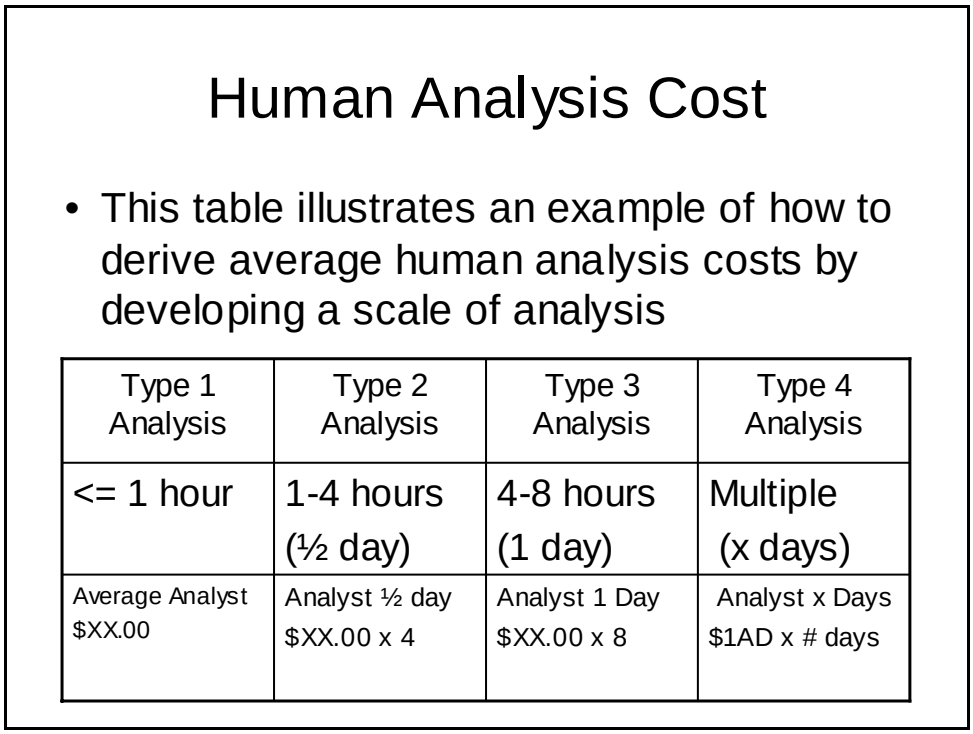

Figure 5. Example of Analyst Cost Basis Determination by Scale

In initial market development, for simplicity, the hourly cost of analysis could be the average analyst cost from junior to senior grade. This average analyst cost should be determined by the market, not the organization. This type of intelligence market cost can be determined in a couple of ways. One method is to look to the commercial market for an equivalent cost; another is to simply take an average military salary hourly cost. This variable can be refined and reflect more detail of the cost difference between analysts (civilian, military, junior and senior grades); however establishing one average cost is recommended for initial market development. The idea is to begin to reflect the cost basis of intelligence for post operation analysis. Exact calculation isn't necessary and careful consideration of just "how many clicks" to state/answer requirements needs to keep this market easy to use.

Daily or routine analysis products that are pushed to multiple consumers and/or posted to a database will also have a published cost. Again this cost is based on the average analyst time used and an average of the raw data typically used in the product. For an organization to determine such a price, they could track (for a period of time) how many analyst hours are used, and how many other resources are used (raw data, tasked assets, etc) to create a typical product offering such as the commander's daily brief.

Once this study is completed, the products average cost is derived and published as the cost basis. Quarterly or annual reviews of daily products should be accomplished to update this cost basis. This is a type of market policy that will help to best reflect the value of items being exchanged on the market.

Certain demand conditions or capacity values for assets and analysis should increase the published cost basis (or point value) of the asset and or product. This is another example of a market policy rule. When an asset, resource, or organization has reached a certain capacity, prices should increase for that asset. The price could increase by some percentage (for example 20%) as a certain demand count or capacity is reached, or when maximum capacity is reached the cost basis could simply double. These are examples of ways to achieve market-like conditions and provide useful operational indicators. In this way a record of reaching this capacity or demand is recorded and prices change much as they would in commercial markets.

In some cases there are alternatives for attaining similar intelligence from assets that are not over capacity, markets now can provide indicators for consumers and brokers to take advantage of alternative available to them. This is useful for any number of assets and organizations such as over-tasked aircraft, satellite, or production organization. In post operation market analysis, these transaction records help provide useful information about resource shortages.

In a similar fashion another market rule is used for priority that changes the cost basis. When assets are being tasked, queuing rules apply. In commercial markets first to arrive is usually first served. For most of the transactions in the intelligence market this will be true as well. However, when higher priority short time frame requirements come in, they need to be treated differently in the military intelligence market. Some “jumping ahead” in the queue may be needed. In such a case, the market way to handle this is to charge a “penalty” to the late requirement that needs to get in front of others. Here again the emphasis on changing the cost basis or point system is to record the transaction differently than others. In the operational environment, these may happen quite often in a changing battlespace. In much the same way as capacity and demand, it is important to record the impact of priority transactions on the market. Where a high priority

requirement comes in, but queuing rules are not violated, then the transaction cost remains at the current market value.

4. Performance Ratings

How well an intelligence asset, analyst, or organization is doing in a market is represented by the demand for the product or asset and measured by the feedback and quality metrics assessed by consumers. How will the military market determine a performance rating for intelligence resources, assets, and organizations? Joint Publication 2.0 offers the following attributes of the quality of intelligence:

- Anticipatory of commander needs for current and potential operational missions and involved in their planning at the earliest time possible.
- Timely- intelligence must be available when required.
- Accurate- intelligence must be factual, estimate future adversary courses of action with sound judgment and describe what is known of the situation
- Usable- intelligence must be tailored to commander's needs, fitting the context of its use, and use language known to the consumer.
- Complete- intelligence must reflect the fullest degree of knowledge of an adversary's capabilities, potential courses of action, and intentions.
- Relevant- intelligence must be related to the current operation and not trivial, and kept up to date with situation changes.
- Objective- intelligence must be unbiased, undistorted, and free from political constraints, because it is often used to derive policy.
- Available- includes timeliness, usability, at the lowest classification level possible (2000).

Some combination of these performance measures should be captured by the market. Consumer feedback and transaction timestamps can provide measures of timeliness. A measure for accuracy and completeness, usability and relevance should be included in consumer feedback. A feedback metric for objectiveness may include a measure of alternative hypothesis and analysis considered by analysis. Like the Elance market, a perfect score for an intelligence product would be a five, but shortfalls in any of these measures will degrade the score. Feedback from the consumer will be required for all routine or planning intelligence, and routinely for database use as well. As presented earlier, these measures are intended to provide the decision maker quality indicators and estimates of the information he is getting. Therefore the measures used in the

intelligence market should be focused on these objectives, and be developed with scale and meaning used by the entire intelligence market.

Requirements should not close until feedback is provided, perhaps with its own incentive system (higher value basis given for faster feedback). Some consideration may need to be given to feedback completion during crises; however feedback is essential, and should be completed as soon a possible. A separate set of long term accuracy performance metrics may be considered for the intelligence market that update metrics as more information becomes available.

Performance based on pure quantities of raw data and analysis made available or provided to the intelligence market is not that meaningful. Another example of a more useful indicator of quality/performance may be shown by the consumer demand for a certain product, organization, or asset. As mentioned previously, demand should be a calculated for databases of raw data or analysis, assets, and organizations. The demand recorded in transactions combined with qualitative performance metrics and feedback are very powerful indicators of performance.

5. Time

Time requirements for intelligence range from planning requirements to just-in-time targeting information. In all cases it is the consumer's responsibility to state the time in which the intelligence is needed. Two time requirements are needed in the VMIM: time to present proposal (bids) and time to present solution. Meeting these timeframe is then the responsibility of solution providers, and may require the attention of brokers, depending on priority. Meeting requirement time is a suggested metrics for performance and feedback.

Some market policies may be employed for time sensitive requirements. As discussed in the cost factors section, in commercial markets queuing rules are usually by first come first served. This is fine for normal operations, but not during operations and crises situations. In these situations, a priority 1 or 2 requirement may have to jump ahead in queue. Broker roles are also suggested for monitoring market transactions to help timeliness; brokers can keep an eye on higher priority time sensitive requirements and make sure they are acted upon quickly by solution providers.

6. Brokers

Brokers are important in the intelligence market. In some cases information exchanges are automatic; this is the case of subscriptions for pull databases or push products. In other cases, such as an intelligence requirement coming out of the field, brokers with situational awareness may need to translate field information requirements into an intelligence requirement for the market. The best use of brokers in the VMIM is to utilize broker subject matter (or area) expertise and place the broker with a perspective of the entire market. In this case the broker can help facilitate the needs of the entire market, and get more requirements fulfilled throughout the market. However, for the operational market user, broker roles are tasked more specifically to facilitate solutions for that operational consumer. In this situation the broker would reach out to solution providers with requirements on behalf of the operational troops. Hence the power of markets-- they can be developed very specifically or very generally, depending on consumer and/or solution providers needs while utilizing the same transaction space.

Brokers are highly skilled members of the Combatant Commander's JICs, JTFs, J2 shops, or direct unit support intelligence officers. Brokers may also be needed at the national level production centers to determine their agency availability and serve as "gatekeepers" for their organizations. If a requirement is routed to a national agency by a consumer without prior relationship to that organization, agency brokers can determine release and/or route of the requirement into the agency, or provide a negative response.

Collection managers are essential brokers for tasking assets. By monitoring capacities available to the market, these brokers can help facilitate as many collection requirements as possible, much as they do today. Working within the VMIM, collection managers and other highly placed brokers may better recognize the shortage of assets or resources that can not be resolved within the marketplace. In this case the broker may inform the Combatant Commanders, who in turn invite other asset/organization participation not normally associated with the market.

Brokers at the JIC or unit level may need to validate new information coming out of the field, quickly. These debrief or sources of HUMINT information are critical to current operational situational awareness. These validations allow the information to

become part of the operational and intelligence picture with the least amount of risk to friendly forces, and help avoid incidents of fratricide.

Requirements that necessitate broker attention will show up by priority in broker queues. Broker identification numbers are recorded on the requirement/solution transaction when a broker role has been fulfilled. Some of the roles suggested so far include: Recommending solution providers, tasking an asset, validating a requirement or its priority, or validating information for release to a database. The value added to the intelligence process by these roles may be determined in market refinement.

7. Market Participation and Location

The intelligence market should exist on the SIPRNET as part of the overall military market. It should reflect all of the transactions between intelligence organizations, assets, databases and analysts. However, based on classification, the exchange of intelligence may be handled on other networks based on classification. The goal of this intelligence market is to get more intelligence at the collateral level, where information exchanges at higher levels are the exception and not the rule.

The market as a whole would be open to all participants. However, the view of each organization and participant would be limited to needed visibility, need to know, and/or invitation to participate. For example, normally the Pacific Command JIC would not see the details of the Central Command market. However, if they have been invited to provide capabilities, those invited entities would have access to those parts of the market not normally associated with their area of responsibility. Figure 6 shows a view of the Operation Iraqi Freedom Intelligence Market.

Figure 6. View of the VMIM OIF Market

The intelligence market appears a number of ways within the VMM. Intelligence would be listed as its own separate market at the highest level of the military market, but parts of it would appear beneath the operational market representing a Joint Task Force, area of responsibility, or national priority such as the Global War on Terrorism.

8. Unit Profiles

The organization or agency's VMIM profile pages lists the products, assets, and intelligence types that an organization has available for a particular market. This is an important record of capabilities present on the market. Portfolio pages would give commanders and analysts the ability to browse for specific reports, capabilities, or options. This profile page would reflect the categories of intelligence that auto sensors would utilize to convey notification of new requirements presented to the market that the organization can meet. Consumers may also query the market for certain capabilities, the list returned would be based on the information in the profile page.

The profile page should also have an indication of an organizations approved operational markets. The case may be that certain regional organizations have not been approved to provide solutions to markets in other areas of responsibility. If this is the case, their reach would be limited to command-approved areas of responsibility only.

The portfolio would reflect that on the registration page, and the unit probably would not have visibility to the other parts of the market, except perhaps at the broker levels. If the restrictions are lifted, and command has authorized support, the approved areas of responsibilities are then indicated on the portfolio page.

The profile page has the published prices of routine products, raw data, etc. These prices only change as a factor of demand reaching capacity and priority rules. Current capacity should be listed on the portfolio, especially for assets such as aircraft or satellites. The profile page has a record of feedback and performance metrics as well. Figure 7 provides an example profile.

Figure 7. Example Profile Page

9. Resource and Unit Availability

The resources for any particular intelligence market are those assigned or invited assets or organizations within the combatant commander's area of responsibility. In open commercial markets, the consumer (or broker) is not particularly concerned about an organization's capacity. However, in these smaller finite resource military markets, capacity is something to be concerned about, and should be represented at both the

organizational and market levels. Thus every organizations/asset's capacity should be presented on the organizations profile page.

This capacity indicator represents the amount of analysis, raw data, or subscriptions available to a particular market. This number is a reflection of an asset's or resources "taskability". For example, how many pictures can the asset provide the market? In the case of analyst capacity this is a far more subjective variable. Coming up with analyst capacity per day (week, month, or year) available to a particular market may be a difficult task. The analysts are involved with more than specific task analysis. In many cases, the bulk of time spent by analysts is not in product creation, but instead is spent reviewing current information and adding to "knowledge libraries" accessible in databases.

One way to state available capacity to the intelligence market is for the intelligence organization to provide an estimation of actual "taskable production" time. For every organization, this will be a different estimate depending on the type of intelligence, number of personnel, their internal process for creating products, etc. This available capacity may change daily, weekly, or monthly depending on personnel/asset availability and down time. The market needs an available capacity for any given time for an organization for a current capacity measure to be reasonably assessed. Caution should be used by organizations, and enforced by brokers that the capacity used and available stay reflective and close to the organization's true capacity. Market rules may be in place for organizations not to accept tasks beyond their capacity. In this way the market can account for this by shifting demand to other organizations. Another example of a market policy fix may be to increase an organization's capacity to more reflect an organization's current production rate if the unit is consistently engaged in "overproduction" (which creates a higher product cost for that organization, based on the value basis rule used) if "overproduction" is sustained.

This is an example of a variable that is refined over time in the market. Units will get smarter about their capacity. For example, if an organization presents 100 hours (per week) of analysis time available and then responds to requirements for that amount of time (uses all of their capacity), that organization is now better equipped to judge its

capacity based on completing the requirements. If the organization is able to complete the requirements on time, then 100 hours is an accurate (or under) estimation of capacity by that unit's leadership. However, if a pattern of late production occurs, barring other issues, then the estimate of 100 hours of analyst capacity may be too high. This estimate of "taskable production" time capacity provides the limit of cost basis that the unit may recover from the market, and may motivate high estimates. This variable needs to be carefully developed and tested in market experimentation.

10. Special Considerations

Special consideration may be needed for long term intelligence activities. Resources and analysts that support national level long term intelligence may have few demands that result in transactions. Because of this these resources may appear underutilized and unproductive. Both incentives and cost basis need to be determined for long term intelligence requirements. Otherwise, organizations would not have incentives to continue to work long term intelligence. One suggestion is to assign general national security requirement identifiers to be collected against. In this way the market can capture the value of all of this type of activity. Another option is to t consider these activities as market exceptions. Other very niche capabilities may have similar issues.

Based on the "who or what" of certain solution providers, assets, and consumers. Some requirements, solutions, etc may be visible by invitation only. These transactions can also be recorded by the market, and approved for visibility by organization or down to the user level if required. This thesis recommends that all possible effort should be made to make all intelligence as widely available as possible; however by the nature of the operation, in some cases that just can not happen. However, a market with a good cryptography protocol can facilitate these needs.

C. ESTIMATES OF IMPROVED DECISION MAKING

1. Current Capabilities

Some of the capabilities presented here exist today in the Community On-Line Intelligence System for End-Users and Managers (COLISEUM) automated production and requirements management system. COLISEUM improves the process for priority requirements by automating registration, validation, and production assignment and allowing deconflicted on-line scheduling of intelligence products. It provides an

automated method of tracking and monitoring production requirements and scheduling, and provides graphical reporting and offers a quantitative metrics basis for performance standards. COLISEUM increased efficient data retrieval for analysts and provided access through IntelLink to intelligence products (Pike, 2002).

Intelligence analysts suggest that the metrics provided by COLISEUM are being used as the source of unit level performance metrics. This database is installed at all Combatant Commands, DOD production centers, DIA, CIA, NSA, Joint Intelligence Centers, and Service equivalents. COLISEUM also provides the products created in a common searchable (by subject only) database.

COLISEUM offers many useful features, many of which would be replicated in the VMIM. So, what is missing? COLISEUM transactions take place primarily on the Top Secret network and are out of reach for many operational units. COLISEUM doesn't record a value basis, or record of resources with the transactions and records only some of the transactions present in the Intelligence Community today, primarily IMINT. Pure quantity of production is not a good measure of success; markets offer ongoing qualitative metrics, updates and long term metrics may be kept about the accuracy of intelligence. Demand should be recorded for all units, assets, and types of products available in the market. COLISEUM doesn't yet handle all types of intelligence and isn't a one stop shop for operator, commander, or analyst. COLISEUM doesn't capture the profiles or capacity of its organizations available to the market.

The intelligence production business process presented in the COLISEUM Handbook (Shook, 2004) is changed when using a market model. The market process involves stating a requirement and having solutions presented much like the business process in COLISEUM. However, the market does not mandate chain of command validation of requirement/solution or assignment (tasking) to a production center. Requirement validation may be required by an organization, but not dictated by market process. In a market model, the production centers determine their ability to answer a request for information or production requirement, rather than having them tasked to them.

The market model provides a value basis missing in COLISEUM. It facilitates the exchange of all intelligence regardless of its source or classification. The market records and encourages transactions at a lower classification to better facilitate the needs of operators. The VMIM uses market mechanics and incentives that focus the utilization of resources and analysis capabilities to meet requirements by having solution providers estimate their ability to answer requirements on time, rather than managers tasking what are thought to be best solutions. VMIM brokers make it their business to answer as many intelligence requirements as possible, and assure that priority and time sensitive requirements are met. Where many requirements disappear into the cyberspace of COLISEUM today, consumers of the VMIM will know who is or is not working the requirement, and if solutions are available by the record on the requirement and/or solution template. Profile pages for each organization participating in the market offer a glimpse to all of a production organizations assets, products, and analysis capability giving the operator a better idea of available resources. Bottom line, the VMIM offers a transaction space focused on meeting demands with incentives to do it.

2. Market Mechanisms Work Together

As suggested in the market model, the VMIM mechanics and transaction space collectively provide better information to the decision-making commander. This happens in part by presenting clear statements of information needs with templates that capture the intelligence requirement as well as through negotiations between operations and intelligence to better refine those requirements. Other examples of the cycle of improved information are offered in Appendix A.

The quality of intelligence can be measured with the right combination of historical feedback, performance measures, and transaction records. For example, how many sources were used to reach the conclusion presented in the hypothesis? Were alternative hypothesis considered and/or asked for in the requirement? Intelligence performance and feedback may change as time reveals the accuracy of a hypothesis. Hindsight is usually 20/20, so feedback and performance measures on some intelligence may require updates to provide the best historical record of accuracy possible. This kind of reevaluation of intelligence is tough medicine; however the market transaction space can support this evaluation of historical evidence better than the potpourri of system

feedbacks available today. The result is better information from all sources available to the decision making commander.

3. Post Operational Transaction Analysis

Once employed in the operational world, the VMIM has a record of all transactions. This gives senior DOD leadership an appreciation for the contributions of organizations, analysts, or assets for any particular operation, period of time, or area of responsibility. The market has a record of all unmet requirements, either because they just could not be answered with current capabilities or because of resource scarcity.

As the DOD steadily moves toward EBO an increased number of intelligence requirements from the operations side will query for EBO battle damage assessments. Intelligence may have difficulty in assessing the more cognitive side of the operational effects. As these difficulties are recorded by the market in requirement definitions, negotiations, and with feedback and performance measurement they will show the need for new capabilities. The requirement will have to be restated and provide the closest assessment possible. Enough such shortfalls and compromises should provide the community an indicator for the need to develop new capabilities and or methods to meet those requirements.

Other post analysis and error checking analysis can be developed for the VMIM. Tendencies can be shown. If a number of consumers are all getting in the same queue for their intelligence products, which is fine if that agency is producing accurate analysis, not so good if it is not. Transactions that record changes and error can be retraced to provide corrections. In this way the market may better facilitate new commander's estimates. Professor John Arquilla maintains that market analysis and error checking may provide measures of improved intelligence not yet conceived (2005).

4. Objections to Intelligence Market

Mark Lowenthal presents some difficulties for intelligence markets in his *Intelligence Reform* chapter. One objection presented is how to determine "fair costs" for any one intelligence product. Another is how to account for less pressing or long term intelligence (Lowenthal, 2003). Lowenthal does suggest that having an understanding of the "true costs of intelligence" will help policy makers make more informed decisions, and that for high priority issues markets may be more effective and competitive.

Long term intelligence was discussed in the special considerations section above. Lowenthal's first objection is handled by the VMIM by recording all of the transaction required by the analyst(s) to answer a requirement. The requirement number is tagged on all of those transactions completed in the market on behalf of that requirement, including those that were actually exchanged on another network. In this way the cost basis of all assets, resources, and analysis is captured by the solution template during the market process. This is somewhat like having a reference page to the requirement, a record of sources and resource costs side of the product.

The after action value of recording such transactions are numerous. Consider just the knowledge management side of this transaction record that provides a useful "off the shelf" solution for analyzing a type of requirement. The analysis approach can be studied, learned from, passed on, improved upon, etc. Young analysts can take a look at their predecessors' methods for analysis, just by looking at the market's solution page of a completed requirement. Such metrics are very useful to intelligence leadership. The other contribution to determining "fair costs" is the number of analyst hours used to answer the requirement. How to record analyst time is talked about in the cost basis section. The market captures analyst time used to create standard and tailored products.

These particular objections are addressed by this market model. Other objections claim that intelligence is "too bureaucratic" or that the problem is "too large" and suggest that markets can not work because of these. Markets have been used throughout history to match needs with solutions at all scales-- large or small, long term and short term. Global markets exist today, and the virtual spaces that make these possible are suited to the needs of intelligence solutions. If the improvements presented in the introduction of this chapter are met, most of these types of objections are simply noise.

Discussions with intelligence professionals about the intelligence market had a lot of questions about internal organizational processes. Such as: "who presents proposals or final solutions to the market from my organization?" The short answer to questions like this is: Markets do not dictate internal organizational processes or decision making. Military markets shouldn't dictate these policies any more than commercial markets tell business how to produce and coordinate their products. These processes and policies are

up to the organization. However, it is quite possible that organizations that do not push product approval down to the lowest necessary level, they will under-perform organizations that have in the market space. Clearly these decisions are product and circumstance specific and should be treated as such by participating organizations.

D. INTELLIGENCE MARKET CONCLUSION

DOD is starting to realize the value of the market environment without precisely naming the solution a "market". General Cartwright, Commander US Strategic Command-- DOD's lead for worldwide intelligence, surveillance and reconnaissance (ISR)-- presents the following prescription:

> A collaborative environment, dedicated to space and global strike, missile defense, information operations, and global ISR—that will enable users to enter into this environment and draw upon the products and skill of all the [component commands], irrespective of where the user has entered the environment (2005).

This recommendation sounds very like the VMIM just presented. General Cartwright wants consumer tailored information at the right time and place and he recognizes that the technology to achieve this is available (Grossman, 2005).

The Marine Corp's development of a tactical fusion center is a well thought out idea. It places the right emphasis on the forward operator while accommodating the needs of higher headquarters. It focuses resources to the guy on the ground (Groen, 2005). In much the same way, by accessing a virtual intelligence market, an operator can get the response of a world-wide market, and at the same time establish new adhoc working relationships that are focused specifically on his needs. The market is suited to the scale of large and small scale operations as well as short and long term needs. This is not reach back or forward—it is "universal reach".

These are two examples of direct correlations to the activities of DOD intelligence today that fit this market model. The intelligence model is summarized next; these are the considerations that make that fit happen.

1. Summary

Here is a summary of the consumers, solution providers, exchanges, incentive, brokers and market policies that are part of the VMIM.

- Consumers: Commanders; Planners; Analysts; Field operators; Policy makers
- Solution Providers: Theatre analysts; Theatre resources and assets; National organization/agency analysts; National resources and assets; Operational forces and HUMINT networks
- Summary of what is exchanged in the VMIM: Requirements captured in templates; Solution proposals captured in templates; All intelligence type products: raw data or analysis; Feedback and performance ratings; A value basis either by cost basis or market points
- Summary of incentives: Exchange of cost basis and record of all transactions– indirect incentives that show the accumulated contribution of organizations and personnel; Feedback and performance measures down to the analyst level that help focus intelligence organizations on meeting intelligence requirements
- Summary of Brokers: Collection Managers – task assets and resources; JIC level broker – priority, time sensitive, monitor overall market traffic; Operational broker – monitor assigned ops, validate/release field data to database, flag priority of this information for market; Production agency brokers/gatekeepers: (DIA, CIA, FBI, NGA. NSA, DOS, DOT)
- Summary of Market Policies: Requirement validation and/or quality check; Priority level 1 or 2 validation; No consumer budgets; Changed cost basis for moving ahead of other requirements and reaching capacity; Policies on feedback; Time policies for priority requirements; Visibility of certain assets, units, requirements, and solutions—also by requirement status and by market participation/invitation; Using scale of effort and average costs to capture analyst and asset costs

2. Conclusion

Many discussions about the need for intelligence reform air similar grievances. Intelligence and military professionals agree that improved measures of success and intelligence effects are needed; that the bureaucracy of the intelligence community

presents its own obstacles for attaining accurate intelligence estimates or process agility. The military is especially dissatisfied with over-classification, stovepipe systems, and the difference between recommendations being made at different levels of classification. Another common grievance is the lack of trust between organizations in the intelligence community as a whole. Intelligence professionals are also frustrated with the over-valuation of technology to fix issues without measurable proof of effect and too few investments into people compared to that technology. Operational decentralization has not been accomplished in the community. These are just some of the concerns about intelligence community's effectiveness and structure.

The demand driven operational VMIM can provide the incentives and performance indicators as well as the collaborative but competitive environment to change many of these cultural issues. The VMIM should coexist within an operations based market to provide an all source intelligence market in a common transaction space. The VMIM provides incentives for participation, a collaborative environment, encourages various organizations to present their piece of the picture and get rid of stovepipes. The market creates an environment of competitive analysis and encourages the presentation of alternative hypothesis. Markets brokers develop quality social network skills. Such skills will refine the leadership skills of intelligence professionals and provide exceptional talents for key senior intelligence leadership positions.

Markets provide effects based performance indicators from the individual analyst to community assets. All transactions are on one market space, and recorded. Markets effectively decentralized operational command and control of intelligence assets and distribution; they simplify the processes and management of crises and non-crises intelligence requirements. Markets represent an entirely new cultural approach to intelligence and establish need to share incentives. Markets can also formalize the receipt of field data into intelligence cycle and just as importantly provide a space for collaboration among experts. Market can also facilitate the swarming of intelligence talent against high priority national security issues when they arise can be accomplished by market forces. The technical solution to accomplish this is not difficult, but the concepts behind this type of transaction activity in the intelligence community have the power to change the entire community.

The VMIM provides the opportunity for new requirements and products to be answered by the intelligence community. One example of this is the need for an information operations assessment of the battlefield during planning. In the current intelligence community, the responsibility for this type of analysis is uncertain. Such assessments need to consider how communication and social networks, global media, telecommunications, satellite availability, etc. impact operations in the information and cognitive battlefield space. Actually, many organizations have key contributions for this assessment, including operational personnel. The market creates the opportunity to answer this by first presenting the commander's requirement. At this point, organizations and market brokers determine what organization can best summarize and analyze this requirement based on available market resources. Subsequent requirements can then be sent to the market on behalf of the original requirement for specialty information exchanges from SIGINT, TECHINT, HUMINT, Civil Affairs, OSINT, sources among others to make this assessment complete. The key point is that markets can produce solutions where they didn't exist before; it allows for the effective creation of working relationships and solutions to meet new challenges.

These are just a few ways that markets have the potential to make positive changes for the intelligence community, further study may prove others. As Professor John Arquilla suggests, it may be argued that "an order of magnitude" improvement may be achieved by market mechanisms for the intelligence community. This thesis will leave that conclusion for market development and experimentation for proof of concept, and the validation of this model.

This use case is not intended to be developed as is. The process to apply this market model to any specific market should involve an extensive review of requirements to be worked on the market, and interviews with all participants from consumer to solution providers to best capture the requirements and facilitate the transactions. This use case presents examples of the considerations needed to develop an intelligence market; its real world implementation would involve extensive research, combatant commander inputs, and intelligence community agreements.

V. THESIS CONCLUSIONS

This chapter presents the objections stated during this thesis research; suggests further research for this model, and presents key take aways for the reader.

A. OBJECTIONS TO MARKET MODEL

Here are the principle objection themes that were presented during the research of this thesis. Most of these can either be overcome through consideration during market development by the use of market policies or with the oversight of brokers.

1. Military is too Bureaucratic for Markets

The idea of this model often gets a strong contrary response from conventional military thinkers. Objectors generally say the military is too bureaucratic for market mechanisms, and that too many lanes are crossed. Using markets to provide better information to the decision making commander can potentially step all over traditional "rice-bowls". This is certainly one reason why alternative C4 structures are being considered: Focus on mission effectiveness versus traditional ingrained solution sets. It is true that market solutions often bypass several layers of bureaucracy; however they have not changed the ultimate authority for decision making or removed any layers of support the decision maker may require. In other words, if the bureaucracy is still needed, this model does nothing but provide indicators of organizational effectiveness. The model is about solving problems with the minds of the many versus the few and if this model proves more effective, based on tangible measurements during validation, then it is time to move on.

2. Information Validation

Air Force Colonel Daniel Scott the Assistant Commandant at the Defense Language Institute Foreign Language Center, reminded this thesis writer that pure ad-hoc information sharing in chat sessions can often lead to fratricide; and that these types of mistakes are costly in American and coalition lives and very embarrassing to the U.S. As suggested in the VMIM use case, this market should be built with validation mechanisms for field data that will help routinize/prioritize the intake of field data. That data should be made available in one of the market's organic databases, in a similar manner to other completed transactions--providing all participants with validated situational awareness.

3. Values Difficult to Establish

Others criticize the attempt to place a "value" on DOD resources, claiming that other attempts to capture values have proven futile. No doubt that an attempt to represent all resources in this bureaucracy is nearly impossible. However, luckily the DOD doesn't have to account for each resource's profit or present an accurate bottom line that the commercial world must; and that's not the purpose of the value basis in military markets. The point is to provide a record of the resources used in a particular transaction, which can be defined as narrowly as desired, as long as the same standard is used throughout the market. As a matter of fact, as long as the resources are identified with the solution, and part of the transaction, a point or cost value isn't necessary at all. The accountants (and the General Accounting Office) can take the aggregate and provide a real dollar value during post analysis, if necessary. With a transaction record of resources only, commanders still have a better picture when using markets than not. As mentioned throughout this thesis, cost basis probably doesn't impact decision making until a vast cost disparity is the only discriminator between solution sets. There are not "spending limits" to effective operations. Bottom line: Value precision isn't the goal, representation of asset and organization contribution to the battlespace is.

4. Military is Overly Competitive

'What happens if no one bids?' During the development of this thesis numerous questions were presented about whether solutions would be presented to market requirements. Quite frankly it would be difficult to imagine DOD forces not coming up with solution sets and taking actions. Sean Naylor, Army Times reporter and author of *Not a Good Day to Die*-- about Operation ANACONDA, suggested that in his estimation the military is far too competitive to operate under market principles. His argument is probably closer to the reality rather than those predict military "under-bidding." To answer this, first, the decision making commander is not out of the picture, he still decides on who goes. Second, market policies, such as not allowing bidding from solution providers over their "capacity" and/or broker roles come into play.

5. Objections to Adam Smith's Free Markets

The final counter argument theme is probably the most valid. This idea is that using markets for military C4 may not always produce the best solutions for the

collective military effort. This has been considered in the development of this market model and accounted for in market policy. Like their commercial equivalents, military market policies are put in place to take these considerations into account. Information validation, priority queuing, capacity indicators are all examples of market policies that help achieve the higher effort required. Their ability to meet the greater good should be tested in model case development and refinement.

B. FURTHER STUDY

1. Develop Other Use Cases

This thesis has explored one market use case. A Joint Force Command operational market should be explored. Coalition markets for specific areas of responsibility focused on ongoing activities such as reconstruction, reconstitution, and security. Disaster relief markets can be set up quickly in familiar transaction spaces a place to describe requirements that outside organizations can provide solution to. A multi-department Global War on Terrorism market can be established. In summary, markets work anywhere transactions happen, choices between scarce resources are made and demands are present as long as the macro variables described in this thesis are present or can be established. Virtual markets require common transaction access space such as the world-wide web or other shared network.

2. Experimentation

Like other models, this market model needs to be completed; it needs to continue the cycle of model development. Interpreting this model for use cases, verifying both it effective operation and improvements, implementing the model in real world operations and maintaining the model are left for further development. Specific markets need to be developed, tested and exercised with in the military--their effectiveness validated.

3. Market Building and Sustaining Processes

As this thesis is concluding efforts are beginning to develop some small real world military markets. The function/effectiveness of those markets based on this model will help validate the concept. As the concept moves from model development to implementation, a market building process is required that will guide the efforts of market developers. Markets are constructed to link consumer and solution provider. So a good starting point to build this market process is to start with the model, identify the

macro variables involved, and then to conduct extensive research and interviews to capture these needs exactly in the virtual transaction space in order to make market participant decision making more effective.

4. Market Analysis

Once military markets are developed for experimentation in the DOD, new market analysis tools such as error checking and indexing should be developed. Methods that use the advantage of recorded transactions to provide higher level indicators for capabilities and force structure. Markets provide indicators and mechanisms that can fix some of our most challenging problems.

In thesis consultation, Professor John Arquilla suggests several higher level analysis methods. Assessing the error checking and/or mitigation in specific markets such as the intelligence market could prove exceptionally valuable. Does the market have a "clearing tendency" that reduces the cycle of bad intelligence assessments? Arquilla also suggest that market failures need to be considered. What would be the conditions for and/or types of military market failures short of market depression or recession?

C. TAKE AWAYS

1. New Solutions- Same Organizations

In many cases the military is struggling with the realities of warfighting in the information age, trying to accomplish better cognitive assessments and determining the cascading and ripple effects of operations and reconstruction efforts. Just one example of this information age struggle is the uncertainty surrounding the participants, organizational structure, responsibilities, and planning for information operations. A virtual market can help achieve the effects desired in information operations without any discrimination about who is able to achieve them. Perhaps some 90% or more of the market solutions are exactly as expected, however markets facilitate new solutions from diverse perspectives. If a new solution's performance is equivalent or better than the "off the shelf" solutions, a new tactic, technique, or procedure has been created.

The market provides a place to state the information space requirement, to be met in sum or part by combining the skills of organizations participating in the market, enabling "power to solve." These solutions may require creative combinations of talents

from a variety of organizations. Warfare in the information and cognitive space require new ways to collaborate and coordinate operational effects and these are not achieved by organizational restructure or changes to unit responsibilities. As organizations start to change their approaches to problem solving in this way, their ability to conduct effective information operations will evolve and integrated operations can be realized. This would be a significant step in the confused space of information operations today.

2. Meeting Spectrum of Conflict with Practiced Adhocracy

This thesis was written with hope that the reader would at least be intrigued by the idea that virtual military markets can perform in routine operations and quickly respond to the needs of crises. Markets are extremely effective at the allocation of resources, and response to demand. Markets are efficient in peace time, transition to and from hostility, and for normal operations for many reasons. Probably the most significant is allows the familiarization and routinization of exchanges and decision making processes in the market transaction space. By routinely focusing solutions to specific tasks, it allows for "practiced adhocracy." Beyond that, post transaction analysis, indexing, and error checking may result in information that is orders of magnitude better than today.

It is interesting to note that commercial markets are at their best when the economy is good – demand is high, and cash is flowing. Military markets would perform at their very best in response to crises and during active operations, because that is when military market demand is highest. Crises and operations require the best solutions possible. Virtual markets present a place for participants to turn for instruction, guidance, and a place to quickly state requirements with expectation that they will be met. Markets provide the decision making commander better information and solution alternatives.

3. Build to Validate

As this thesis concludes, efforts are being made to build and test drive smaller markets for the military, more expansive C4 exercise efforts should be undertaken as well. Virtual markets can be developed to meet a variety of needs, not all are challenges to traditional command and control. Military markets can enable the knowledge and power of the many against the asymmetric threats faced by the U.S. The VMM is an alternative C4 structure that should be considered for use today. Build this market model for C4, and test the validity of this hypothesis.

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APPENDIX A. DECISION MAKING IN MILITARY MARKETS

This appendix shows how the lessons from existing decision making theory and tools can contribute to the development of market mechanics. Markets should be developed to provide a cycle of improved information for the decision making commander within the market transaction space. Decision theory and analysis present useful considerations for fine tuning markets to make this happen.

This discussion also shows how the DOD can start to re-emphasize the principles of Effects Based Operations (EBO), with the understanding that current operations must operate within the realm of current capabilities. The EBO may not be fully attained because the existing DOD tool set can not achieve it. With market mechanisms the DOD can estimate how close to EBO solution it is with available operational choices.

A. IDEAS FROM DECISION THEORY AND ANALYSIS

This market model has created a transaction space for receiving alternatives for operations and EBO solutions. How then is a decision made between solutions? The decision maker may have to choose the best option available at the time and may not be able to fully achieve an EBO. The choice of a solution for the operation should be that which is closest to actual EBO attainment. The next section reviews some methods that can lead to good decision making for EBO and this market model.

1. Decision Theory

Decision theory offers decision makers a structure for problem and solution analysis. One decision theory method combines a capability's probability of success with its utility and reaches an expected value for each choice. The following definition and decision criterion is presented:

> **Expected Value** is a key concept in probability theory, statistics, and decision theory. The expected value of an experiment or strategy is obtained by multiplying the value associated with each possible outcome of the experiment or strategy by the probability of achieving that outcome, and then summing the products of these multiplications. Faced with several possible strategies, a decision-maker who is neither very conservative nor much of a gambler might be expected to choose the strategy having the highest expected value (Castro, 2000, p. 16).

The process to reach an expected value has two steps: First determine subjective probability of an outcome. This is the "degree of belief one has in the likelihood of the outcome" (Lyons, p. 543, 1997). The second step is to provide utilities of the various consequences. Better decisions are made from cardinal values where utilities are considered in relationship to each other. For this to be true for a 1-100 scale, something that is 100% likely is twice as likely as something that is 50%. What is important is the ratio of differences between values shows something about the commander's preference (Straffin, 1993).

By combining a solution's expected value with the unit's historical performance metrics the best solution available may be identified. To determine which solution to select for an EBO, first the commander should list an EBO by the key attributes to its successful accomplishment and provide the importance of that attribute on a cardinal scale. This list of attributes and their cardinal utilities become the decision making criteria for the commander. This is developed further in a decision analysis tool discussed in the next section.

2. Decision Support Analysis

Figure 8 shows a decision support template and example from the U.S. Army's Logistics Management College. The spreadsheet depicts five helicopter alternatives for an operation. It follows some, but not all, rules of probability and steps to determine expected value. This spreadsheet illustrates how individual attributes of a decision can be assessed for each alternative solution A1 – A5. The attribute data is entered in the top table, and each attribute is ranked by the commander's importance with a cardinal scale on the bottom line of the lower table. The commander for this solution has ranked reliability as the highest priority 100 and maneuverability the second priority at 80. In this model that means that maneuverability is 80% as important as reliability to the choice of solution. Since this is a cardinal scale, each of these attributes can be compared in this manner. Solution A4 has the highest reliability score and is represented with the highest utility of 1 all the other solutions receive cardinal utilities compared with this best attribute solution. Each of the other attributes utilities are calculated in the same manner. The resulting weighted average in the second table's right column combines the commander's utilities (bottom line importance) with the normalized attribute utilities for

each alternative, and then adds each alternative's utilities to create a score for the decision maker.

Decision Support System Excel Spreadsheet
U.S. Army Logistics Management College
School of Management Science
Version 4.0

	Attributes					
Alternatives	Cruise Speed	Climb Rate	Pay Load	Cost	Reliable	Maneuver
A1	145	580	2625	3.5	7	7
A2	175	415	2750	4.9	5	5
A3	190	500	2700	3	7	3
A4	150	450	2550	2.5	9	7
A5	140	425	2500	5.1	5	5

Decision Support System Excel Spreadsheet
U.S. Army Logistics Management College
School of Management Science
Version 4.0

Ben=1							
Cost/Ben	1	1	1		1	1	
Alternatives	Cruise Speed	Climb Rate	Pay Load	Cost	Reliable	Maneuver	Score
A1	0.76	1.00	0.95	0.71	0.78	1.00	0.86
A2	0.92	0.72	1.00	0.51	0.56	0.71	0.68
A3	1.00	0.86	0.98	0.83	0.78	0.43	0.76
A4	0.79	0.78	0.93	1.00	1.00	1.00	0.94
A5	0.74	0.73	0.91	0.49	0.56	0.71	0.65
Importance	35	45	30	60	100	80	

Figure 8. Weighted Value Score for Army Helicopter Solutions

There are problems with this weighted value template. First, it assigns a cardinal utility of 1 for the best solution available. In some cases an attribute may have an absolute constraint, and this needs to be considered. In this Army helicopter example a payload may need to be over 2700 lbs to be considered for the mission at all. In this case, then all solutions that do not meet this payload constraint need to be eliminated from the acceptable alternatives altogether. Thus, it must be assumed that all attributes reflected in the decision table have met the constraints for each attribute. If they do not meet the constraints, they should be removed as an alternative for selection, regardless of other attributes.

The second problem with this template is that the weighted utilities of each attribute are added. This is one of the fallacies often associated with utility theory, and is

equivalent to adding apples and oranges (Straffin, 1993). In this case the utility scale is from one source (the operational commander), still these attribute utilities are not necessarily additive. So, some caution need to be used when reviewing this decision model's results. However, this additive basis is a common practice when comparing alternatives. The authors of the simple additive weighting model caution that the aggregate score needs to be at least 5-7% higher than the next solution to be a definitive selection between the options because of the models subjective basis (David, 2004).

Other methods of comparison could be used instead of adding utilities. For example minimizing risk between attributes or weighted averages of constraints. Or the use of goal programming to maximize value or minimize constraints. The purpose of this illustration is to show the specific benefits of market mechanisms that provide information to the operational commander. By determining the commander's decision criteria the market developer can better refine market mechanisms to provide the information needed. These decision making criteria differ between markets. For example, the qualities of intelligence products on the market are significantly different from the criteria for selecting an operational package. Markets provide a common process for making decisions without restricting the commander's decision basis. The next section illustrates how the commander's information can be improved for one type of operational decision.

B. MARKET MECHANISMS FOR IMPROVED DECISION MAKING

Decision theory and analysis ideas help to set the conditions for setting up market mechanisms correctly that result in significantly improved decision making for the operational commander. Market mechanisms can do this first by providing available solutions for commanders to choose from and second by providing specific information and estimates that better predict the probability for successful attainment of an EBO. This second part can be accomplished by a well considered use of the statement of requirement, the solution provider's estimates in bids, and finally by tuning performance factors to all of these. The result is a cycle of better and better information for the decision maker. This section provides the market developer some ideas of how to get better information to the decision making commander with market mechanisms.

1. Statement of Requirement

This thesis assumed that the proper analysis was accomplished to state a specific EBO to the market. The best available market decision for achieving these EBO can be determined by some additional analysis of commander's intent, priorities and decision making criteria. What is important to achieve this is to list the attributes necessary for operational success, and provide the priority of the commander for each of these within the statement of requirement. The requirement should also state which attributes of the operation are constraints; for example if your probability for any one of these constraint attributes is below some threshold then it would not be considered as an option. See an example of EBO attributes in Table 2. Then with bid submission the solution provider provides the estimate of success for each attribute.

EBO example: Take out a Power Grid at coordinates abc, xyz for a two week time period from the beginning of D day until D day + 14.

Table 3. Attributes, Constraints, and Utility

Attribute	Description	Constraint?	Weighted Importance
1	Power is taken out	Yes ≥ 90%	100
2	Repairable	No	70
3	Achieve time objective (on time and sustained during operation)	Yes ≥ 80%	80
4	Coordinated with all related operations	No	40

2. Solution Provider Probability Estimates

For each attribute important for command decision making the solution provider should estimate the probability for successful attainment of each. This helps achieve the first step in determining expected value by establishing the subjective probability of each attribute. The solution template should list the EBO and the attributes considered important to the commander, see Table 3. As mentioned earlier, if a solution provider provides submits a solution that can not meet certain constraints, it wouldn't be considered an alternative for command decision. For the EBO mentioned in the requirement that means that the probability attribute # 1, take out the power, needs to be estimated over 90%; and the probability of the time attribute (# 3) needs to be over 80%.

Table 4. Solution Attribute Subjective Probabilities

Attribute	Description	Probability
1	Take out power	[1-100]
2	Repairable	[1-100]
3	Able to achieve time objective (on time and sustained during operation)	[1-100]
4	Coordinated with all related operations	[1-100]

3. Performance Factors

These probability estimates could be considered in the performance factors recorded by the market during post operation assessment. By measuring a solution provider's ability to accurately estimate the probability of success for achieving certain operational attributes, the commander has a better idea about the quality of information being received with solutions. By measuring this as a performance factor, solution providers are highly encouraged to provide their best solution estimation. If the solution provider knows that for this EBO that the power grid attribute of repairable can not be achieved, the provider should say so with a low probability of attaining that attribute.

4. Combined Decision Analysis

Combining the information from these market mechanisms starting from the statement of requirement through performance factor is shown in Figure 9 and 10. This uses the attributes sent out by the commander in the requirement template, takes account of the subjective probabilities estimates from the solution providers and captures costs and historical performance metrics.

Decision Support System Excel Spreadsheet
U.S. Army Logistics Management College
School of Management Science
Version 4.0

	Attributes					
Alternatives	Pow er Out	Repairable	Time Period	Coord	Cost basis	Performance
AF Sortie	0.98	0.01	0.98	1	155	96
Hacker	0.9	0.98	0.85	0.6	25	67
Special Ops	0.93	0.6	0.93	0.75	50	85
Army Op	0.85	0.5	0.85	0.7	76	62
Navy Sortie	0.96	0.01	0.96	0.95	125	92

Decision Support System Excel Spreadsheet
U.S. Army Logistics Management College
School of Management Science
Version 4.0

Ben=1

Cost/Ben	1	1	1	1		1	
Alternatives	Power Out	Repairable	Time Period	Coord	Cost basis	Performance	Score
AF Sortie	1.00	0.01	1.00	1.00	0.16	1.00	0.76
Hacker	0.92	1.00	0.87	0.60	1.00	0.70	0.88
Special Ops	0.95	0.61	0.95	0.75	0.50	0.89	0.84
Army Op	0.87	0.51	0.87	0.70	0.33	0.65	0.76
Navy Sortie	0.98	0.01	0.98	0.95	0.20	0.96	0.74
Importance	100	70	80	40	0	0	

Figure 9. EBO Decision Matrix

Each of these solutions meets the constraints set by the requesting commander. In Figure 9 the commander doesn't have cost or past performance weighted in the solution (see importance line). Notice in this first estimation of the solution without consideration of the solution provider's historical performance, the hacker solution has the highest score. However, in Figure 10 when past performance is valued equally with the most significant attribute, the special operations solution gets a better score. The scores in these example are too close to determine a definitive choice, however the commander has better information about the solutions under consideration and all solutions that do not meet critical constraints have been eliminated.

Decision Support System Excel Spreadsheet
U.S. Army Logistics Management College
School of Management Science
Version 4.0

	Attributes					
Alternatives	Pow er Out	Repairable	Time Period	Coord	Cost basis	Performance
AF Sortie	0.98	0.01	0.98	1	155	96
Hacker	0.9	0.98	0.85	0.6	25	67
Special Ops	0.93	0.6	0.93	0.75	50	85
Army Op	0.85	0.5	0.85	0.7	76	62
Navy Sortie	0.96	0.01	0.96	0.95	125	92

Decision Support System Excel Spreadsheet
U.S. Army Logistics Management College
School of Management Science
Version 4.0

Ben=1

Cost/Ben	1	1	1	1		1	
Alternatives	Power Out	Repairable	Time Period	Coord	Cost basis	Performance	Score
AF Sortie	1.00	0.01	1.00	1.00	0.16	1.00	0.82
Hacker	0.92	1.00	0.87	0.60	1.00	0.70	0.83
Special Ops	0.95	0.61	0.95	0.75	0.50	0.89	0.85
Army Op	0.87	0.51	0.87	0.70	0.33	0.65	0.73
Navy Sortie	0.98	0.01	0.98	0.95	0.20	0.96	0.80
Importance	100	70	80	40	0	100	

Figure 10. EBO Decision Matrix with Performance

Additional analysis of the criteria can distinguish the alternatives by the least amount of risk: as a sum, average, or by weighted average risk depicted in Figure 11. In this decision analysis the lower the risk the better. In all cases when past performance is considered-- the Special Operations solution is the best option. Throughout this example the cost basis has not used in the estimation of risk and hasn't been identified by the commander as part of his decision criteria.

	Attributes- Probability					
Alternatives	Pow er Out	Repairable	Time Period	Coord	Cost basis	Performance
AF Sortie	0.98	0.01	0.98	1	155	96
Hacker	0.9	0.98	0.85	0.6	25	67
Special Ops	0.93	0.6	0.93	0.75	50	85
Army Op	0.85	0.5	0.85	0.7	76	62
Navy Sortie	0.96	0.01	0.96	0.95	125	92

	Attributes- Risk					
Alternatives	Pow er Out	Repairable	Time Period	Coord	Cost basis	Performance
AF Sortie	0.02	0.99	0.02	0	0	0.04
Hacker	0.1	0.02	0.15	0.4	0	0.33
Special Ops	0.07	0.4	0.07	0.25	0	0.15
Army Op	0.15	0.5	0.15	0.3	0	0.38
Navy Sortie	0.04	0.99	0.04	0.05	0	0.08
Importance	100	70	80	40	0	100

Alt	Sum Risk	Avg Risk	Wt Risk
AF Sortie	1.07	0.214	0.197179
Hacker	1	0.2	0.185641
Special Ops	0.94	0.188	0.168205
Army Op	1.48	0.296	0.287179
Navy Sortie	1.2	0.24	0.221795

Figure 11. Alternatives and Attributes by Risk

C. CONCLUSION

The information provided by the market contributes to improved decision making. Careful consideration should be made when developing the transactions in the market that focus this. This appendix presented just a few ideas from decision theory that can be easily captured when using market mechanisms. As mentioned earlier, the decision making criteria by market type and even specific decisions may vary. What is important to the market transaction process is that it facilitates the presentation of decision criteria in a meaningful manner so that it can be met by solution providers. This decision making transaction process is then replicated every day in virtual markets.

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APPENDIX B. VMM PRESENTATION

A. EXECUTIVE SUMMARY: VIRTUAL MILITARY MARKETS

- The Virtual Military Market (VMM) Intelligence use case (V-MIM) starts to paint the picture of how E-Bay like markets can be utilized by DOD to improve the intelligence C4 process. Profitability doesn't matter to the DOD; however effective distributed operation capabilities-- especially for decision making and information sharing does matter. The V-MIM use case explains how virtual markets are planned transaction space for "practiced adhocracy" and advocates for experimentation and exercise for validation of the concept.

- The force transformation buzz words "*self-synchronizing*" and "*demand driven*" are words that have been associated with markets throughout history. Consumers drive markets and create opportunities for solution providers to meet the demands—in other words markets synchronize supply and demand. MIT's Professor Thomas Malone introduced the concept of internal markets to answer the needs for alternative C4 mechanisms with today's technology.

- Markets are an organizational principle and a means of thinking about coordination that have existed since the Byzantine Empire. Both adhocracy and markets may be evil terms for the military. In organizational theory, markets are at the very outer edge of adhocracy, they are not really organizational forms at all, but transaction spaces between individuals and organizations that focus relationship and exchanges based on resolving requirements.

- A new breed of market, called a virtual market, has emerged at the intersection of markets and information technology. These markets provide extensive reach to the most distant of consumers. Today the web offers virtual markets such as E-Bay and Amazon. Something closer to what is being illustrated here is called Elance. Elance is a professional services market that allows accountants, web designers, translators and others to bid on buyer requirements. E-Bay, Amazon, and Elance are good examples of global

markets, enabled by information technology. These information age markets are available to anyone with internet access, and enable the realization of another transformation phrase, *Power to the Edge*.

- Virtual markets are not technically difficult; they have just extended the reach of the consumer and supplier. This fact is the key to market utility - no matter how complex virtual markets are used, what is important about them is their ability to link the demand of consumers with the innovation of suppliers. Translating that into the military environment, virtual military markets are able to respond to the needs of the Joint Forces Commander's demands for: information and intelligence, new solution sets for effects-based operations, and reach to remote & specialized skills of all types. The C4 demands of routine operations, crises and planning can be met by the VMM.

- Markets are efficient in normal peacetime operations for many reasons. Both familiarity and routine are gained in making transactions in this market space, always increasing the quality of the decision maker's information and solution sets. In other words normal operations allow for "practiced adhocracy". Market analysis, indexing and error detection can provide indicators and mechanisms that can fix some of our most challenging intelligence problems.

- Commercial markets are at their best when the economy is good, demand is high, and cash is flowing. Military markets, also driven by demand, would meet their challenge, and perform at their very best, in response to crises and during operational situations because that is when military demand is highest. Imagine a new crises event- reaction is needed immediately- the VMM presents a place for military forces to turn for instruction, guidance, and a place for commanders to state requirements and have some expectations that solutions will be created for their consideration. The VMM is a C4 process model for today.

B. PRESENTATION

Virtual Military Markets: Intelligence Use Case

Major Angela Burth, USAF
Student, Naval Postgraduate School
September 2005

1

My name is Maj Angela Burth, I am an AF Comm officer, currently at NPS pursuing a MS degree in Info Ops. This fall I join the JCS's CIO Office at the Pentagon.

I started thinking about E-Bay like markets for the military last fall in Prof John Arquilla's Warfare in the Information Age class. He presented the idea of posting operations on an E-Bay type website to be grabbed by special ops troops. That nugget sparked a thought in my mind of not just posting operations but actually "marketizing" the choice of forces by costs and performance factors. I thought about this a bit, and encouraged by Prof Arquilla to "hold on to that thought", I decided to explore markets in my Thesis. I had a brief discussion with Prof Dorothy Denning, about the topic at the start of winter classes in January. The Denning family is communicating! The next day I met Professor Peter Denning and Professor Sue Higgins; Dr. Denning wanted me to work a deal with EBay to get the market software and start to develop the market. My response-- develop what..?

In two winter classes with Prof D. Denning, I explored both the cyber side of markets and their social network organizational structures. I accomplished a related literature search and leveraged my MBA and org design courses. I uncovered ideas about internal markets from Prof Thomas Malone at MIT, and I referred back to lessons of force and idea swarming from Prof Arquilla. I found important need statements that I felt markets could meet from the DSB, OFT, and CCRP.

I then translated the virtual markets we are all familiar with into the military environment & rule sets. How many of you have been on EBay, Amazon? Closer to what I'm trying to accomplish here is Elance, a profession services market that asks for solutions from accountants, web designers, translators and others.

This brief takes that one step further, and start to paint you a picture…of how virtual markets can be utilized by DoD. To do this I present an intelligence use case.

Overview

- Why markets for the military?
- Today's intelligence needs
- Intelligence markets prescribed
- Market concept of operations
- Way ahead – how to validate

2

Before going into the details of this case presentation I want you to consider the following. When you hear the words "self-synchronizing" or "demand driven" what do you think of? Besides being force transformation buzz words, these words have been associated with markets throughout history. What drives markets? Technology? No, consumers drive markets and create opportunity for solution providers to meet their demands. Markets synchronize supply and demand.

What is interesting about markets when combined with information technology? A new breed of market, called a virtual market, has emerged. Markets that provide extensive reach to the most distant of consumers. E-Bay, Amazon, and Elance are examples of global markets, enabled by information technology. These information age markets are available to anyone with internet access, and that brings to mind another transformation phrase. *Power to the edge*. Profitability doesn't matter to the DOD; however effective distributed operation capabilities especially for decision making and information sharing does matter.

Now a technologist could purport the complexity of these markets and use words like "complex adaptive system or network", but what does that mean anyway? To the bane of all engineers and technologists alike it means that there are humans involved! The problem must consider the chaos of human decision making and can not be solved with pure technology strategies. Virtual markets are not that technically complex, they have just extended the reach of the consumer and supplier. That is the key to markets, no matter how complexly they are employed, what is important to the market isn't technology but a process that links the demand of consumers with the innovation of suppliers. Keep this in mind when thinking through how virtual market mechanisms can be translated into military operations and organization. Not a difficult technical solution; but an **organizational** principle and means of thinking about coordination used since the Byzantine Empire.

Both adhocracy and markets are almost evil terms in the military. In organizational design markets are at the very outer edge of adhocracy and are really not organizational forms at all, but are transaction spaces between individuals and organizations that facilitate relationship and exchanges. **By the end of this presentation** I hope your are at least intrigued with the ideas that virtual military markets can perform in routine operations and quickly respond to the needs of crises. Markets are extremely effective at the allocation of resources, and response to demand.

It is interesting to note that commercial markets are at their best when the economy is good – demand is high, and cash is flowing while military markets would perform their very best in response to crises situations because that is when demand is highest: image a new crises event, where reaction is needed immediately, virtual markets present a place for everyone to turn for instruction, guidance, and a place to state requirements and have some expectation that they will be met.

Markets are efficient in peace time as well for normal operations for many reasons. Probably the most significant is allows the familiarization and routinization of exchanges and decision making processes in the market transaction space. In other words it allows for **practiced adhocracy**. Markets also provide indicators and mechanisms that can fix some of our most challenging problems. Indeed demand drives markets in the military and commercial worlds. With that analogy what does a recessed military market indicate? Pack your bags lads, go home, there's peace on earth.

Certainly the challenges of asymmetric warfare and 4th Generation Warfare will keep the US military guessing for years to come. This presentation will show how many present limitations and shortfalls can resolved with collaborative market processes & practiced adhocracy. Markets focus on demand, and perhaps change how we come up with and how we think about solutions. Virtual Military Markets empower the many to come up with solutions for the Joint Forces Commander. It does not take the selection of those solutions away from the commander.

I walk through a very specific use case for the intelligence community and illustrate how market mechanisms can fix vexing intelligence problems.

Organizational Principles

- Markets are transaction spaces between multiple organizations & individuals
- Internal Markets are within an organization that allow for the decentralization of command and control
- Virtual Markets allow far reaching market transactions
- Adhocracy
  - The absence of hierarchy/bureaucracy
  - Relationships focused by purpose to its completion
- Common/familiar transaction language used daily = "practiced adhocracy"

5

Here are some of the organizational principles that are involved in markets. This thesis combines the ideas of Henry Mintzberg's taxonomy of organizational Forms and Thomas Malone's alternative organizational structure that can meet the challenges of command and control in the information age.

Functions of Internal Markets

- A forum for exchange
- An arena for competition
- An avenue for choice
- A process for endorsement/external validation
- A mechanism for resource allocation
- A kind of social network

(Välikangas & Hamel, 2001)

6

Here are some of the functions of internal markets presented by a pair of researchers in 2001. Markets are not just for capitalist purposes. What is important for internal markets is finding the right incentives that encourage exchanges. It could be that in DOD markets, prices or common values wouldn't even be exchanged, perhaps resource use is simply recorded. However as I will show later, the record of these transactions provide powerful after action analysis.

Getting Past Biases

- Internal markets mechanisms can be used without profit motivation – use other incentives
- Markets are incentive-based transaction spaces designed to facilitate exchange & meet demands
- Market mechanisms and structures do not replace organizations—although they may provide indicators for long term change

7

There is a military cognitive bias against markets: "cost savings" and profit do not necessarily fit with military activities. As I have just talked about markets may be used for other than capitalistic motivations and they do not replace organizational structures they allow organizations and individuals to make transactions in virtual space.

Internal Markets in Hierarchies

- World Bank Development Market Place
  - Two days, participants from around the world
  - $300 million available for the top 300 projects
- Royal Dutch/Shell Oil GameChanger
  - Employees, select universities, partners
  - Existed on 1% its own revenues in 2000
- IBM alphaWorks
  - Releases new software modules to get feedback from developers—who get a head start in development

8

Here are a couple of examples of Internal Markets used in traditional hierarchies that were very successful.

The World bank searched for grass roots project ideas in a market place, the result was that 4 of 9 highest priorities of the World Bank 2001 came from that marketplace.

Shell's GameChanger division comes up with new innovations for the corporation, it successfully produced 4/5 largest growth opportunities for the company.

And IBM's alphaWorks project releases new code to developers on the condition that they provide feedback. This gives the developer a head start on technical development. Keep these types of incentives in mind when thinking about markets.

Intelligence Needs

- 9/11 Report
  - Restructure of intelligence community
  - Increased information sharing with incentives
- Incentives to stop hoarding information to bolster organizations position--black holes
  - Change what is valued by the community
  - From "Need to know…to Need to share"

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Expressions of intelligence needs are pervasive. The 9-11 report summarizes two primary need for the intelligence community. The need for the community to restructure and to increase information sharing with incentives.

What is repeatedly found in most criticisms of the intelligence community are the messages in the second bullet. Stop hording, change what is valued by the community, change the culture from need to know to need to share. These are criticism are found in many readings as you will see in the next slides

Reference 2004 9-11 Report p.417 Information Sharing

Intelligence Needs (cont)

- Measures that show efficient analysis, collection, and operations support
- Changed transactions processes & structures to meet the goal of agility
- Access to value added expertise that is flexible and has surge analyst capacity
- Improved requirements process
- Creation of intelligence reserve for crises
- Properly balance redundancy and duplication for competitive analysis

(Lowenthal, 2003)

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Here is a summary of intelligence needs presented by Mark Lowenthal in his 2003 book, Intelligence from secrets to policy.

Lowenthal p. 224 in Mark M. Lowenthal, *Intelligence: from Secrets to Policy*, (Washington, D.C., CQ Press: 2003) Intelligence reform chapter "volumes of reports or "batting averages" are not useful measurements.

Counter-Insurgency Intel Needs

- Intelligence sharing out of stovepipes
- Timely & relevant HUMINT information
- Intel officers with increased social network skills and established relationships with counterparts in other organizations
- Alternative (competing) hypotheses
- Protracted nature of the requirement
- Global network of networks- all nodes are users and producers of intel

(Grau, 2004)
(Sullivan & Bunker, 2002)

11

Similar statements to meet the needs of counterinsurgency intel shown in two articles here.

Guerrillas, terrorists, and intelligence analysis: something old, something new Lester W. Grau

Multilateral counter-insurgency networks from John P. Sullivan and Robert J. Bunker

Ops Lessons Learned

- Lessons learned from Afghanistan
  - Need for culturally centric HUMINT
  - Few US intel organizations could contribute "actionable" intelligence post kinetic phase
  - Need to focus intel community on tactical operator
- Push collection and analysis downward
- Creation of global scout experts
- Leverage learning sciences-increase skills

(Scales, 2004)

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The Need for Culturally centric intelligence tactics and HUMINT is presented by MGen (Ret) Scales in a Sept 2004 Proceedings article on Culture-Centric Warfare

Scales, R Jr. (2004). Naval Institute Proceedings. *Cultural-centric warfare.* Vol 130/10/1220 Oct. 2004.

Views From the Field

- *"I could probably get more usable intelligence from a séance," quips one officer with recent Iraq experience.*
- *"Ultimately, if you collect [intelligence] but don't disseminate it to the warfighter, it's useless," says one officer recently returned from Iraq. "You're just soaking up electrons in the atmosphere."*
- *"The intelligence community is so layered and so compartmentalized that the only secrets they keep are from themselves," says one Marine officer who has served in Iraq, speaking only somewhat in jest."*

(Grossman, 2005)

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Some recent field comments about intelligence.

From *Inside The Pentagon* by Elaine M. Grossman May 5, 2005

Why a Virtual Intelligence Market?

- Increase focus on the intel consumer
- Common process and language for transactions for the entire community
- "One stop shop" for consumers & analysts
- Focus on "need to share" to meet demand
- Meet the need for counter hypothesis
- Provide incentive that motivate the "Need to share"
- Qualitative measurements of intelligence
- **Bottom line: A process that adds value and start to change the intelligence community that we can do today**

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For this question … A virtual intelligence market makes sense and is my response to **many** of the challenges presented.

Gen Cartwright's Prescription

- A **collaborative environment** dedicated to space and global strike, missile defense, information operations, and global ISR
- *Enables users to draw upon the products and skill of* ***global component*** *commands*
- *Provide tailored information based on* ***consumption needs*** *-"end-running" the problem*
- *"It's* ***not*** *a technical issue anymore"*

(Grossman, 2005)

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Recently General Cartwright, Command US Strategic Command presented this prescription. This looks very familiar… a collaborative environment, reach to global component, to meet consumption need.

from ***Inside The Pentagon*** by Elaine M. Grossman May 5, 2005

U.S. Forces In Iraq Face Obstacles In Getting Intelligence They Need

Virtual Tactical Fusion Centers

- Marine Corps Tactical Fusion Center-- Iraq
  - Meet intel needs of forward ops units (in context, relevant)
  - Meet higher headquarters' intel needs
  - Excellent model for how to handle information overload of the tactical & operational commander
  - Individual focused support on a few operators
- New virtual tactical fusion capability from a world-wide market
  - Initial response from the world-wide market
  - Develop new adhoc working relationships-quickly
  - Taking care of a few units--get smart fast

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I want to highlight one lesson learned from the field. The Marine Corp's development of a tactical fusion center is a well though idea. It places the right emphasis on the forward operator while accommodating the needs of higher headquarters. It focuses specific resources to the guy on the ground. In much the same way by accessing a virtual market an operator can get the response of a world-wide market, and at the same time establish new adhoc working relationships. The market is suited to the scale of large and small as well as short and long term needs. This isn't reach back or reach forward this is "all reach".

The Tactical Fusion Center (Groen, 2005)

Assigned forward units = advocacy cell, forward position analysis = understand context, conditions & relevance

Virtual Market Basics

- Who are the buyers?
- Who are the sellers?
- What products or service solutions are exchanged?
- Incentives to provide solutions- recorded transactions
  - Money (budget and billets)
  - Ratings (how well I did it)
  - Status (I was involved!)

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No matter what market you are trying to establish. These are the basics. Who are the consumers? Who are the solution providers? What are they exchanging? What are the incentives for the exchange?

The exchanged cost basis may never equate to dollars for the organization or perhaps with changed legislation they could between U.S. Departments. These transaction records could definitely be used by decision makers at all levels for determining budgets and billets in the DOD. For national agencies, this score card could be used differently. Cost basis exchanged with transaction is probably an indirect incentive for participation, and not used so much for choices. Valuable information for commander's to use for future decision making. Running total of how well solution providers are doing. Record of who did what where, even from remote access. A firm count of contribution and involvement.

Notes: Reward scheme based on observables – outcome of success or failure (imperfect link to effort), success = bonus, fine for failure; also called equity sharing; get by what can't be observed; other observable= success/failure of previous project (also inexact), but better with more observations; two ways =historical record of performance or compare with others. Dixit, A., & Nalebuff. B (1991). Pgs 305-306.

Intelligence Market Prescribed

- Variety of exchanges in the intel process
  - Ops & Planning Intelligence requirements
  - Raw data
  - Asset and resource tasking
  - Field data submission
- Feedback for all products and databases
- Costs/value recorded in transactions
- Choice of existing consumer product template or tailored
- SIPRNET market for all INT

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There are a variety of exchanges involved in the intelligence process today. A market mechanism can facilitate them all

Added to these, the virtual military market would have exchanges of feedback and performance ratings, some cost or value basis, and consumer format preferences. The Virtual Military Intelligence Market should be developed as an "All INT" market on the SIPRNET.

Examples:

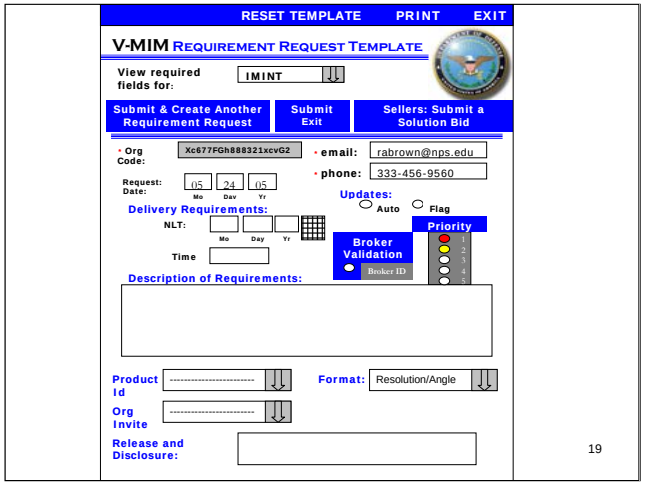
Operational intelligence requirements: such as battle damage assessment.

Planning intelligence requirements: adversary or country studies and target identification.

Raw data requirement by intelligence analysts.

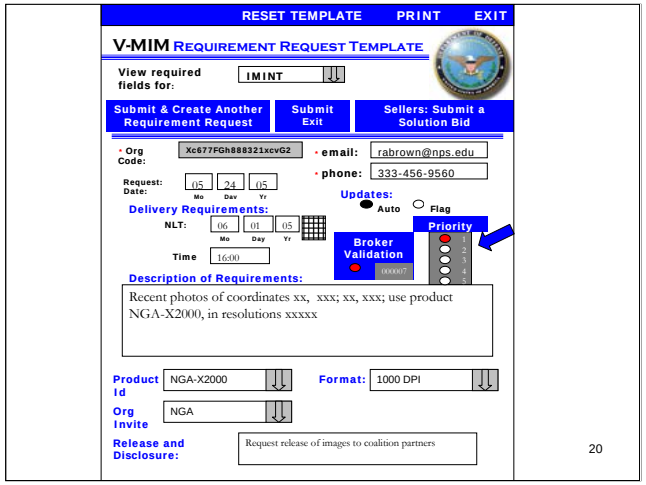
Asset and resource tasking: collection brokers to respond to intelligence requirements

Adhoc data collection by fielded personnel and sensors



I start to paint the picture of the intelligence market and discuss the use case at the requirement template instead of the broader market environment because this is what drives the market. **This is what I as a consumer, the buyer, the commander need from the market to get my job done**. Without this, a market need not be established.

Here it is an online form. This template would show the required fields by selected intelligence category. This is an example of an IMINT template. When a consumer fills it out, his organization and contact information are automatically filled in, as well as the operation he is involved with and request date. The request date is kept updated until submitted to the market. The buyer fills in the needed NLT time, and delivery instructions. Another network may need to be used to actually exchange the data. (Much the same as choosing between FEDEX and US Mail) Buyers can select Automatic or flagged updates. Users can place a priority on the requirement where priority 3 is normal, priority 2 high priority, and priority 1 Life or death can be selected by the consumer, but must be validated by a market broker.



When the template is submitted, the solution providers are notified of new requirement in the market that they can potentially fill, and market brokers are notified at the same time. Here the broker has validated a priority one requirement. The broker would also help choose solution provider from bids (field operator request). The broker becomes involved with high priority requirements if there was no response in a given time to a high priority requirement, he will invite solution providers based on organizational capacity.

Solution providers submit solution bids directly from the requirement template with all or some: List of prepared products (push products); List of database with relevant material and specific items that consumers already have access to; or Tailored product estimates.

The buyer in the intelligence market can take all solution providers' products, some or none. At this time there isn't a budget on the consumer, for intel, various analysis and competing hypothesis are ofter better.

Like other virtual markets, the top level will direct your actions based on your purpose in the market to buy products or sell products.

Buyers can post requirements, search for resources or capabilities, and take a look at the Org profiles for organizations participating in the operation. Sellers can register, search all requirements or by go the an active operation or the intelligence market for it.

Other market links are available, such as the markets of the combatant command, functional commands, & links to other Coalition, NGO, or a topical market such as the Global War on Terrorism.

Here the buyer wants to enter the OIF market

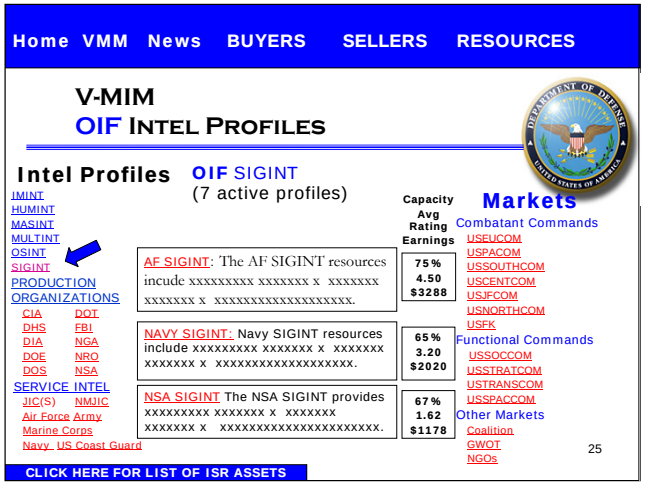
The OIF intel market again directs the user based on how he is participating.

The buyer- posting a project, searching for available resources or capabilities, browsing organizations.

The seller- reviewing requirements by priority or specialty. The market shows or link to hot intel requirements, high priority intel requirements, and unmet needs. List of resources for OIF are also listed

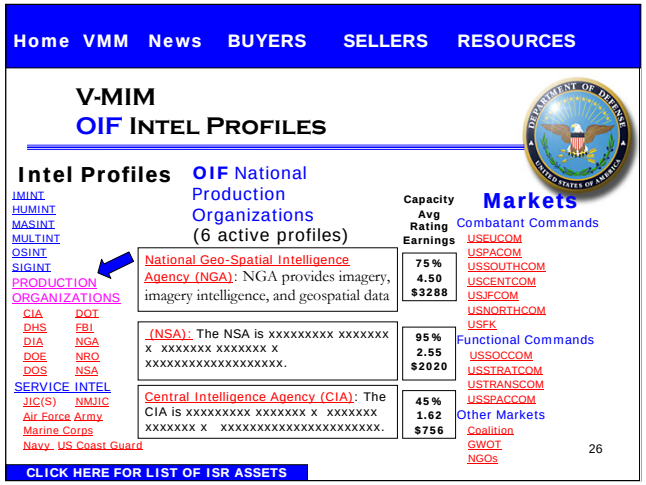
Another useful link would be a capacity warning list that shows organizations at or reaching their capacity. This page has links back to the OIF market.

Here the buyer wants to look at the organizational profiles participating in OIF.

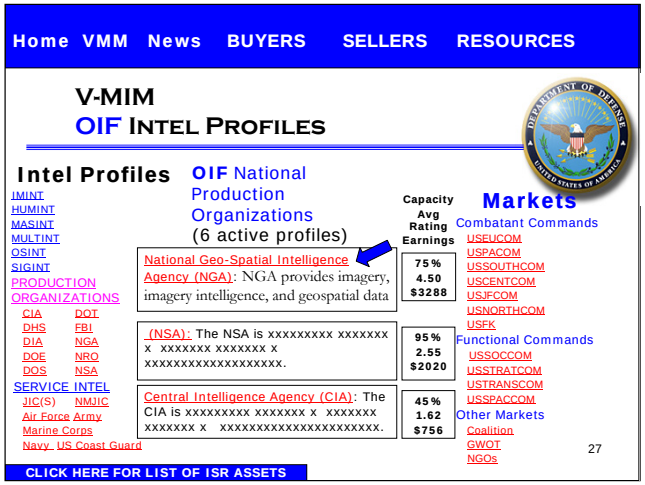


These are the organization profiles that are active in the OIF Intel Market, representing both assigned and invited organizations.

Here the user has selected to view the SIGINT Profiles active in OIF. The listing displays the current used capacity of the organization, its average ratings, and the amount of product it has produced for this market. They can also view the profiles by service or by (next slide)



By a list of National Production Agencies that are active in the OIF market.



Here the user want to take a look at the profile page for the National Geo-Spatial Intelligence Agency (NGA).

This is a look at NGAs organizational profile page. The page should show all products available from an organization, it should list its taskable assets and show both asset and analysts capacity. This is an important record of capabilities present on the market.

The individual product pages will present a portfolio of available user formats, and their reference number for the requirement template. A list of supported operations and/or AORs should also be available. A link to all of the organization's feedback should also be present.

Field Data & Ops Debrief Interface

- Exchange for sensor/shooter information
- Patrols, checkpoints, drivers, and aircrew debriefs can provide excellent HUMINT
- Incentives (price) for this information
- Intel officer entered then validated by broker before release to debrief database
- Database interface template
- Database & items rated by consumers

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Another important template that should be developed is this field data and ops debrief interface to facilitate the exchange of our own field operator HUMINT. This would go (among other places) into one of the market's organic databases – a Field Data Repository. An operations template would be developed that offered a selection of formats from a pull down menu (for example aircrew or ops unit post mission HUMINT report). This information would be filled in by a debriefer or ops personnel, and depending on market rules, the information would be routed to brokers for validation and release to the field debrief database. The operator & broker may flag the priority of the information to show up in HOT topics for the operational and intelligence markets.

OIF Database Listing Page

- List of all OIF relevant databases with link to them or link information (to other networks)
- Link to all databases in V-MIM
- Subscription rates (yearly, monthly rates)
- Capacity of subscriptions - how many subscriptions issued vs. how many planned for
- Follow individual links to database portfolio page that has-examples of product in database and database subscription sign up

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A database listing pages can be accessed at various levels that show relative information for the operation. Users are offered a link to the entire database listing of the V-MIM as well that captures intelligence products produced in the VMIM if they are release for general consumption.

Brokers

- Skilled intelligence market personnel
- Validators for field data & release to database
- Provide situational awareness and links between ops & analyst to facilitate requirement flow
- Today's JTF, JIC & Service "J2" shops
  - Monitor market for flows
  - Validate & prioritize requirements
  - Invite special skilled analysts & assets based on priority requirements
- Collection mangers
- Agency brokers (DIA, CIA, NGA, NSA)

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Brokers are important in the intelligence market and have a number of roles and various locations. Brokers along with market policy are intended to make up where Adam Smith's Laissez-Faire- the invisible hand- will not meet the collective military needs, as argued by John Nash who finds the need for market policies and arbitration.

Illustrations:

In some cases information exchanges are automatically exchanged, in the case of subscriptions to pull databases or push products. In other cases, such as an intelligence requirement coming out of the field, brokers with situational awareness need to translate field information requirements into an intelligence requirement for the market. Brokers are present as skilled members of the Combatant Commander's Joint Intelligence Centers (JIC)s, or direct unit support intelligence officers. Brokers are also needed at the national level production centers to determine their agency availability and relevance. Collection managers are also necessary brokers for tasking assets. Depending on how a requirement is submitted to the market, many of these brokers may get a heads up ping that a new requirement is present, and start their organizations response. JIC or unit level brokers may need to validate new information coming out of the field, quickly. This allows the information to become part of the operational and intelligence picture. Brokers in all of these circumstances need the social network skills of knowing just where the expertise is present in the intelligence market for specific information.

Examples of Market Indicators

- Capacity utilization trends
- Aggregate record of demand and transactions
- Participation level of organizations & assets
- Unmet requirements (shortfalls)
- Performance measurements
- Record of unique products and solutions

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Here are just a few examples of post transaction analysis indicators that should be apparent after a period of market operation that can be used in higher level DOD decision making.

Other Market Considerations

- Cost Determinates (human, product, database)
- Performance Metrics and Feedback
- Demand Counts and Capacity indicators
- Prioritization of Requirements
- Refinement of Requirements to achieve EBO

- How market mechanisms work together to improve decision making

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These are other market items that I have considered for the use case, many of these have slides in the market mechanisms section in the back of this brief. All of these are discussed in more detail in my thesis to be published by NPS in September '05.

Current Capabilities: COLISEUM

- Community On-Line Intelligence System for End-Users and Managers
  - Automated requirements - production
  - IMINT some SIGINT
- Centralized database of products
- Access to current intelligence products
- Quantity metrics & some quality measures

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Some of the capabilities presented here exist today in the Community On-Line Intelligence System for End-Users and Managers (COLISEUM) automated production and requirements management system. COLISEUM improves the process for priority requirements by automating registration, validation, and production assignment and allowing deconflicted on-line scheduling of intelligence products. It provides an automated method of tracking and monitoring production requirements and production scheduling. COLISEUM achieves a centralized database with remote access. It provides graphical reporting and is a starting point for metric development for performance standards. It increases flexibility with efficient data retrieval for analysts. "COLISEUM also provides a requestor/validator capability through IntelLink to access current intelligence products i.e.: National Intelligence Daily, Military Intelligence Digest, NMJIC Executive Highlights, Defense Intelligence Report, Daily Intelligence Highlights, Chairman's Morning Brief, etc." (Pike, 2002).

Intelligence analysts suggest that the metrics provided by COLISEUM are being used as the source of unit level performance metrics. This database is installed at all Combatant Commands, DOD production centers, DIA, CIA, NSA, Joint Intelligence Centers, and Service equivalents. COLISEUM also provides the products created in a common searchable (by subject only) database.

COLISEUM shortfalls

- Accessibility
- Market incentives to share
- Recorded values of information
- Registered profiles and products
- Feedback on all products
- Consumer & analyst "one stop shop"
- Field data validation and access
- Social network & broker knowledge

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COLISEUM offers many useful features, some of which would be replicated in the VMIM. So, what is missing? COLISEUM transactions take place primarily on the Top Secret network and are out of reach for many operational units. COLISEUM doesn't record a value basis, or record of resources with the transactions and records only some of the transactions present in the Intelligence Community today, primarily IMINT. Pure quantity of production is not a good measure of success and demand should be recorded for all units, assets, and types of products available in the market. COLISEUM is also not well connected to operational market. COLISEUM doesn't yet handle all types of intel and isn't a one stop shop for operator, commander, or analyst.

The market model provides a value basis missing in COLISEUM. It facilitates the exchange of all intelligence regardless of its source or classification. The market records and encourages transactions at a lower classification to better facilitate the needs of operators. The VMIM uses market mechanics and incentives that focus the utilization of resources and analysis capabilities to meet requirements by having solution providers estimate their ability to answer requirements on time, rather than tasking what is thought to be the best solution. VMIM brokers make it their business to answer as many intelligence requirements as possible, and assure that priority and time sensitive requirements are met. Where many requirements disappear into the cyberspace of COLISEUM today, consumers of the VMIM will know who is, or is not, working the requirement, and if solutions are available by the record on the requirement and/or solution template. Bottom line, the VMIM offers a transaction space focused on meeting demands with incentives to do it and gains the knowledge of "the many".

Way Ahead

- Experiment in exercise for validation - proof
- Develop this market model using generic market software and place it on the SIPRNET
- Intel/Ops participants with national agencies
- Specific Validations
  - Market can meet time to respond
  - Broker roles
  - Demand, capacity, & cost factors performing
  - Improvements over existing process

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Here's what is needed next, experimentation, what Professor Peter Denning wanted me to do in January.

In this case exercises could be accomplished in the virtual spaces, by volunteer organizations, far removed.

I propose that this intelligence be developed on the SIPRNET. While not all data exchanges can take place there, transaction records can happen in one market. Here is a list of specific validations to accomplish. So then what? How do we know this is better than the Intelligence Process of today?

Market Intelligence Improvements

Prove with experimentation = measurably better than today

- Increase focus on the intel consumer and provide tailored analysis for operational needs
- Provide a common process and language for IC transactions
- Create a "one stop shop" for consumers & analysts for all intelligence transactions
- Provide incentives that improve intelligence sharing and collaboration and change intelligence community focus to "need to share" to fill consumer demands
- Routinize data management & validation from operational and HUMINT sources

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Here is a list of items that can actually measured during and after experimentation. I suggest that they would all be proved better than the existing intelligence process.

Improvements (cont)

- Increase awareness of organizational and community capabilities and skills
- Better prioritize intelligence requirements globally, regionally and locally.
- Utilize otherwise unused analysis capabilities (spare capacity)
- Reach remote specialized skills and analysis
- Provide a common transaction space for multi – intelligence products
- Provide a single process for crisis and routine intelligence requirements that has reach to the entire intelligence community

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Market Intelligence Improvements

New or added values not present today

- Intelligence quality indicators and measures of effectiveness
- Increased incentives for competitive analysis and alternative hypothesis
- Provide intelligence database administrators with feedback measures
- Increase awareness of organizational capabilities/skills
- Provide new knowledge management
- Post transaction analysis and error checking

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Here is a list of Metrics and incentives that are new for intelligence markets, these would provide improvements that are not present today. They would simply be demonstrated with experimentation.

The combination of these intelligence improvement leads to a cycle of improved information for the decision making commander. For a more detailed summary of this topic, see Appendix A of the Virtual Military Market Thesis.

Other Markets

- Iraq coalition coordination markets for reconstruction, reconstitution, security
- Disaster relief markets
- JFC operational market- ideally the intelligence market is part of a "market of markets"
- GWOT multi-department market

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Other places for markets? Anywhere transactions happen, choices between scarce resources are made and demands are present.

I have presented an intelligence market as one use case. I'm sure you can think of your own virtual markets locations. Ultimately the virtual military market is in a "market of markets" that gives the Joint Forces Commander all the information, knowledge skill, & force selection options available to develop the best coarse of action for an Effects Based Operation. Markets can be used for planning and execution.

Conclusion

Virtual Military Markets are Planned Transaction Space for "Practiced Adhocracy"

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My question for you, have I gotten you even close to understanding that markets are planned transaction spaces for practiced adhocracy? Are you intrigued enough about markets in the military to consider the idea for the next step: experimentation. I open the floor for discussion.

For a more complete discussion of the Macro Variables or micro transaction space market development , see my Virtual Military Market thesis. Expected publication date by September 2005.

Market Components

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Purpose of Exchange Prices

- No limits to exchanges other than asset or analyst capacity
- Profitability not goal
- Recorded transactions for analysis
  - After action records
  - Provide long range market indicators
- Start producing mechanisms for metrics/feedback for effects based operations

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The purpose of "prices" in the military market are primarily for post analysis and comparison purposes. The exchange of a cost basis is an indirect incentive to participate in a military market. Decisions are not necessarily made because something is cheaper, etc. In military markets, how successful a solution performs is a better measurement. However, the power of recording all transactions in some way (by cost basis or points, etc) is powerful for post transaction analysis. Recording a cost basis is a good representation of a market, because the cost basis is where commercial markets would start to compute their pricing strategies. In a military market, these recorded transactions become interesting when accumulated over a time period, by operation, etc (See analysis slide)

Notes: The best market analysis comes from true costs being reflected (and not inflated, or under inflated) (Thinking Strategically, p. 321) Thus the market should probably use costs derived from common charts that are shared. (In other words, calculated automatically and not actually submitted with bids, the bid is more a statement of resources expected to be used in the solution).

Standard Product Cost Determination

- Routine products
  - Current intel briefs & summaries, military capabilities summaries, target graphics, etc
- Product prices based on average:
  - Cost of raw materials*
  - Cost of human analysis**
- Prices published to portfolio page
- Prices changed by capacity count

* Prices derived in the same manner as tailored products
** See human analysis cost slide

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Non dynamic prices for standard products (perhaps updated quarterly or annually)

Tailored Product Cost Determination by Market

- Cost of Raw Materials
  - Database access by subscription*
  - Tasked asset published costs
- Cost of Human Analysis**
- Cost calculation included in solution bid
- Price changed by organization capacity reaching predetermined limits

* Recommend recovery of subscription cost by first x number of products
** See human analysis cost slide

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When tailored products are presented back to the consumer as solutions they should provide the estimated resources of raw materials and amount of human analysis time expected to be used. The costs are then automatically calculated based on market mechanic.

Human Analysis Cost

- This table illustrates an example of how to derive average human analysis costs by developing a scale of analysis

Type 1 Analysis	Type 2 Analysis	Type 3 Analysis	Type 4 Analysis
<= 1 hour	1-4 hours (½ day)	4-8 hours (1 day)	Multiple (x days)
Average Analyst $XX.00	Analyst ½ day $XX.00 x 4	Analyst 1 Day $XX.00 x 8	Analyst x Days $1AD x # days

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Here are some suggestions for establishing a scale of analysis:

Average price for 1 analyst hour may be $20 or $30, ways to determine = look to commercial world, or divide up average military salaries to an “hourly rate”.

Then calculate a representative scale of effort. This one is only a suggestion, because it may be difficult to present solutions estimated down to the hour. Similar methods can be used to determine other costs by scale, so that solution presentation are easier.

Notes: Argument for cost basis to be recorded in transaction: In commercial markets or not for profit markets, prices are set to at very least recapture costs. Otherwise the organization is out of business. Cost basis is a good place to start to establish value basis of the entire market and its individual components.

Other methods: points for transactions. Fine as long as market scale is maintained. IE an analyst hour is one point across the board, satellite images are x many points.

Database Subscription Rates

- Year rate for one analyst subscription*
- Some lesser value for short term
  - Monthly, quarterly, etc

IMINT Subscription	SIGINT Subscription
1 Year $XXX	1 Year $xxx
1 Month $XX	1 Month $xx

*Subscription based on estimated annual database cost figure recuperated by some number of subscriptions

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Here subscription rates are presented by the yearly and monthly rates. Subscription are based on estimated annual database cost figure recuperated by some number of subscriptions. This would vary significantly based on where the raw data came from, next slide.

Database Annual Cost

- Number of items in the database
- Collection cost estimate--asset costs assessed from original source (one or many assets)
- Human analysis conducted? % of DB items
  - By analysis type (1-4)
  - Add analysis cost to that % of items
- Add publisher & database admin cost per year*
- Determine # subscriptions expected to cover costs to determine price

* Publisher or database administrators other than analysts

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Demand Counts –> Capacity

- Product prices are charged as posted or derived until demand exceeds certain capacity
  - Subscription rates increase after # attained/year
  - Raw materials prices increase by asset tasking exceeding some % capacity
  - Analyst products increase after demand over time exceeds some % normal capacity
- Demand metrics can work with priority to determine queuing rules of assets or analysis

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Here are some example market policies that involve the demand and capacity counts.

Example of a capacity count: the asset is tasked at capacity, to get priority in queue requirement needs to be high priority and pay more than "back of the line", and meet its time requirement. In this way, the market can respond to time sensitive targeting, and high priority operations.

It also presents a measured metric for how often an asset or organization exceed capacity and encourage alternative solutions or asset taskings to meet the current demand and the need for additional resources is evident when capacity is reached too often.

Performance Metrics

- Database feedback (monthly, quarterly)
  - Quality measures of value of database
  - DB item feedback for specialty products, field data, analysis products
- Tailored products – per item feedback
- Value for submission of feedback or penalty for non-submission
- Feedback submitted no later than …(post operations)

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Here are some examples of performance metrics captured in feedback from consumers. It may be useful to update feedback and performance metrics with time. This needs to be considered in market development and experimentation.

Measures of Intel Feedback

- Anticipatory of commander needs
- Timely- available when required (range)
- Accurate- intelligence must be factual & estimate future adversary courses of action
- Usable- tailored to commander's needs
- Complete- reflect the fullest degree of knowledge
- Relevant- intelligence must be related to the current operation, not trivial & up to date with situation changes
- Objective- unbiased & undistorted
- Available- includes timeliness, usability, at the lowest classification level possible

(Joint Publication 2-0, 2000)

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Joint Publication 2.0 offers these attributes of the quality of intelligence: These and other measures should be considered for the VMIM such as the use of alternative resources and hypothesis.

Policy Needs

- Those things that the "invisible hand" will not facilitate in the market
- Intel Use case: queuing rules by priority & response time (jump in queue = cost more)
- Broker roles in each market may vary
- Demand counts and capacity indicators
- Specialty Cases

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Prioritization Mechanism

- How to mitigate in a "market" way
- Rules to get into queue ahead of those waiting
  - Validated higher priority (ie level 1= life or death)
  - Pay a higher cost than others in line if time can't be met otherwise
- Important that these priorities get met, and are properly reflected in the market and recorded

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Thought slides

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Special Cases

- Long Term intelligence not accounted for
- Niche capabilities may not be well represented by the market
- Identifying National Security Strategy supported requirements could account for much of the collection that takes place for these (Policy level)

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Other VMIM thoughts

- Capture sources used for final product
- Choices of currency, score card , or cost basis
- Assets that only certain operators can see?
- Same for requirements--with limited or solicited only views
- Visibility of market by user id
- Feedback/performance measures ongoing?
  - Found to be wrong later (IE Iraq WMD)
  - Trace back analysis
- Indexing and error detection
  - How is the market doing?
  - Everyone getting in same queue (good or bad?)
- Representation of alternative hypothesis considered/provided

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Relieve Ops Info Overload

- Hard to process information at tactical level
- Markets with distributed analysis help reach all capabilities & tactical fusion centers
- Centers with capacity to process-- respond
- Help to focus "front line" on intel sensor input, context development, etc. less on analysis
- Reach to analysis & distributed processing of imagery, SIGINT, other tailored products
- JIC brokers & Intel analysts respond

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Virtual Markets can help to relieve Operational Information Overload in these ways.

Markets Increase Knowledge Skills

- Intel market is also a knowledge repository
  - New analysis methods and other solutions are quickly considered and replicated
  - New data sources exploited
- Transaction space allow faster acumen of valuable intelligence skills
  - Example analysis templates
  - Product success evident by demand

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Adaptability and Scalability

- Markets are extremely scalable
- Able to respond to crisis or new operations
- Meet normal operations and change priorities for crisis
- Short or long term relationships

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Markets are highly scalable from normal transactions to high priority. New requirements and markets can be established in short order to facilitate reaction to new operations

For continued study

- Develop virtual market prototype to experiment with
- Develop other use cases IO, OPS, hastily formed networks for disaster response, etc
- Experiment
  - Refine transaction space & rules for one market
  - Validate roles & operational requirements met
  - Validate improvements to existing system
- Develop role out plan
  - Possibilities, one op/AOR at a time
  - Get most/all intel organizations required for that market to participate
- Develop market analysis tools – error checking, commander's review, asset utility scales

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